Essays on Banking and Finance

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Declaration

The contents of this thesis are original work by the PhD candidate. It contains no material that has been presented for a degree or diploma of any university. To my knowledge, it contains no material previously published or written by another person, except where duly acknowledged in the text.

Hong Kong, May 2013

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Abstract

This thesis looks into two specific topics regarding the relationship between bank lending and the economy. The first is about how non-performing loans (NPLs) are treated by individual banks, how their actions affect their viability, as well as its impact on the market for collateral. The objective is to provide insight into the decision-making process of a typical bank, and how decisions made from such a process impact on asset markets. The second topic relates to the transmission of monetary policy changes through variations in the volume of bank lending in Australia, with particular reference to the firms sector. Insight on this channel of transmission can contribute to the literature on how monetary policy is transmitted through the banking system and affects the wider economy.

Chapter 2 explores the incentives that banks face when treating bad loans. Since write offs frequently involve losses, capital adequacy requirements present a binding constraint on banks' plans for liquidating bad loans. When bank safety is threatened, banks are forced to evergreen loans to bad customers and profitability is thus reduced. It is demonstrated that lowering regulatory capital requirements can ease this constraint and allow more liquidation of bad loans when liquidation is desirable.

Chapter 3 investigates the effects on the asset market of bank actions in dealing with their NPLs, by extending the model in Chapter 2 to include interactions with the market for collateral. Results show that liquidation of bad loans may not be as detrimental to asset prices as commonly argued, because funds recouped from liquidation can be recycled into new loans which support the asset market. While

capital regulation protects the bank health, it may sometimes limit the amount of liquidation and hence reduce the impact of the 'recycling channel'. This supports the idea that varying capital requirements countercyclically can dampen the economic cycle, notwithstanding the potential problems with making this a tool for economic management. Additionally, this chapter finds a distinction between two types of forbearance, that based on bank profit maximisation, and from concerns over a bank's financial health.

Chapter 4 makes use of aggregate time series data in Australia to look into the strength of the bank lending channel of monetary policy. Investigation is done by examining whether monetary aggregates affect the spread between bank loan rates and bond rates. Results indicate that for small firms, the strength of the channel is dependent negatively on the size of the real deposit base. This is because deposits represent the supply of bank loans which if increased lowers bank lending rates. For large firms a different mechanism operates suggesting reduced influence of the channel, shown by larger loan volumes coinciding with a narrowing spread, implying that banks prefer to concentrate on lending to larger businesses. Rises in foreign funding coincide with a widening spread, but after a lag they also help to reduce upward pressure on loan rates, suggesting a weakening of the channel as foreign funding rises to relieve pressure on the market for bank loans.

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Chapter 1

Introduction

This thesis studies two main problems related to the day-to-day operations of a typical bank by focussing on how bank lending can potentially influence the economy. Specifically, the first topic of interest is on the way non-performing loans (NPLs) are treated in the banking system, how bank action on these loans will impact on the economy through affecting the health of the banks themselves, and also the amount of bank loans supplied as a result. Second, the effect in Australia exerted by the volume of bank loans and foreign funds in transmitting monetary policy, and how firms of different sizes fare in obtaining funds, are examined. The three chapters that follow will investigate, respectively, how banks deal with the NPLs that arise typically as a result of struggling borrowers defaulting on loan payments; how these decisions impact on banks themselves and their interaction with collateral markets; and the degree to which monetary policy in Australia impacts on the economy through affecting the supply of bank loans.

Even though NPLs occur in all economic climates, they are much more prevalent in times of economic distress, and the media frowns on banks when foreclosure of loans start to threaten homeowners and small businesses. This is so because of the belief that other segments of society are so reliant on bank lending to continue their normal activities. Ever since the global financial crisis broke out in 2007, to this day there are periodic reports of high-level debates on how banks can play an important role in intermediating credit that is so scarce for so many sectors of

the economy. Identifying the strength of the bank lending channel through which monetary policy is transmitted is an important topic as it informs policymakers about the efficacy of manoeuvring the policy interest rate. It is important to see what factors can affect monetary policy, one of two main policy levers available to authorities, through influencing the volume of bank loans.

The reason why the question of NPLs attracts much attention from the media and other sections of society is because they are frequently viewed as the main cause of problems that threaten to hinder the subsequent recovery of the economy. The experiences of the Great Depression in the 1930s and in Japan in the 1990s provide fertile ground for opinions from opposing sides of the spectrum. While some advocate faster disposal of bad loans, others suggest a slower pace would be better for the economy. An extreme supporter of the faster clean up approach was Andrew Mellon, US Secretary of the Treasury during the Great Depression, whose advice in 1931 was to:[1]

> Liquidate labor, liquidate stocks, liquidate the farmers, liquidate real estate. It will purge the rottenness out of the system. High costs of living and high living will come down. ... Values will be adjusted, and enterprising people will pick up the wrecks from less competent people.

This point of view is primarily based on the premise that producers that have ended up in trouble tend not to be dynamic enough to revive an economy. Hence it is better to have troubled firms shut down, and banks can then move on to make loans to new firms that shall help the economy recover. During the Asian financial crisis in 1998, the IMF has been arguing for a quick resolution of NPLs by asking countries to set up asset management companies and inject public money into banks to fund massive write-offs. There are other commentators representing the industries who also seek an early end to the NPLs problem, see for example Wallison (2002). This opinion is echoed in the academic world by such authors as Peek and Rosengren (2005) and Caballero, Hoshi, and Kashyap (2006).

[1] **Hoover (1953).**

At the other end of the spectrum, there are those that are concerned with the damage that quick liquidation can do to the economy, and hence argue for moderation in clearing the NPLs. For example, in a series of newspaper commentaries, Krugman argues that quick restructuring of the Japanese banking sector is not likely to achieve much.[2] In a similar vein, Koo (2003) applauds the actions of the Japanese government in tackling the NPLs problem slowly. The rationale behind this view is that any drastic action to clear the NPLs in the banking sector will not yield large and immediate benefits: the damage to banks will dominate and therefore the economy will be injured further. Included within some of these comments is the concern over added pressure on asset prices from firesales. These commentators generally favour policies that do not force the banks to write off large amounts of bad loans, such as demand side stimulus packages that try to revive the fortunes of the borrowers.

Despite the apparent appeal of the arguments advanced by both camps, and heated debates over responses to NPLs problems, the actions of the banks themselves frequently do not conform to either desired ideal. For example, the Japanese NPLs problems persisted for a long time despite calls from the highest offices for a quick solution.[3] One reason may be that these opinions from outside the banking sector do not take account of banks' private consideration, such as the institutional features within which banks operate, and are only concerned with macroeconomic and asset market stability.[4] There is a need to investigate the banks' private incentives to further understand why they may choose actions that do not conform to either camp.

At the same time, arguments over how NPLs impact on asset prices are frequently based solely on the one-sided observation that selling collateral into the market decreases its price, and therefore to clean bank balance sheets (whether by

[2] An example of this opinion is Krugman (2001).

[3] In 2002, then Prime Minister Koizumi named the NPL problem as a top priority issue and asked the Bank of Japan to take action to enhance "the prospects for an early resolution of the so-called 'non-performing loans problem'." See Japanese Ministry of Foreign Affairs (2002).

[4] See for example Nishimura and Kawamoto (2003) and Kocherlakota and Shim (2005).

banks' own will or enforcement by authorities) during downturns will magnify negative wealth effects. Yet this action is almost certainly not the only thing banks do in disposing of their NPLs. For example, account must be given to the subsequent use of funds by the banks. The recouped funds can either be hoarded to boost the capital ratio, which enhances a bank's safety, or lent out to other firms. The activity created by the new lending, and its impact on asset prices, is frequently left out in debates over NPLs. An understanding of the overall impact of NPLs on asset markets is therefore necessary.

The study in Chapter 2 looks at the incentives that a representative bank faces in dealing with its NPLs. The partial equilibrium model developed is simple in nature and takes profit maximisation as a working assumption of a typical bank. When deciding on a course of action on delinquent loans, the bank makes a decision over expected profit of continuing with the current borrower, or to call in the loan and lend out the funds to someone else. The other major concern for this bank is the loss that comes with writing off bad loans threatening its stability. Since meeting the minimum capital adequacy ratio is a universal requirement for banks and a restraint on their financial position, the bank must also take this into account. Accordingly, the approach taken to analyse how this concern interacts with disposal of NPLs is to examine the changes in bank balance sheets brought about by writing off delinquent loans, and how bank behaviour is restrained by these changes.

A peculiar yet not uncommon practice of commercial banks regarding treatment of NPLs is embedded in the model presented here. While there are guidelines in the Basel Committee documents and national regulations, sometimes banks take to creative accounting measures to either conceal or 'dress up' delinquent loans. This thesis considers explicitly the behaviour of some banks which do not recognise their bad loans on the balance sheets. This was a common occurence in the 1990s in Japan. As such, their capital ratios were arbitrarily inflated, and did not fall foul of regulators.[5] This kind of practice is closely related to the slightly more complex

[5] In fact, they were sometimes implicitly allowed by authorities, since strict enforcement would

practice of 'evergreening', where delinquent loans attract new loans from banks equal to their unpaid interest. The firms then pay it straight back to the banks so that the interest payments appear current and the loan is not non-performing, at the cost of an ever growing principal.[6] The net result is also to give banks the appearance of satisfying capital regulation. When practiced in today's world, with mark-to-market regulations in place, these techniques potentially give banks even more of an advantage because otherwise the bad loans not only attract a capital charge under Basel regulations, marking down the values of loans classified as bad also leads to a direct decline in profit, which further reduces the capital ratio. In such cases banking authorities must stand ready to inject large amounts of funds into banks when NPLs occur on a substantial scale. A case in point is the current trouble some banks are having with Greek debt.

The contribution this thesis makes to the topic of NPLs is to analyse how banks treat their impaired loans when profitability interacts with capital regulation. The abovementioned techniques of concealment are expressly pitched at avoiding contravention of minimum capital adequacy. Since in theory no bank can have less capital than the regulated standard, choosing an ideal level of NPLs tolerance becomes more complicated than simple profit maximisation. It is shown that because of capital regulation, sometimes banks are forced to engage in two different types of forbearance – one as a result of risk taking for profit, the other to avoid writing off bad loans so that the capital ratio does not drop. These actions are quite different to either opinion over the speed of NPLs clearance described above.

In reality, the analysis is complicated by a number of other regulatory requirements, such as rules for making provisions for specific contingencies, and limits on lending imposed by national authorities, but only the obligatory capital requirement is considered to show how a bank deals with this kind of regulation in a representative way. Capital adequacy requirements are included in the analysis because

push many banks into trouble and induce systemic instability.

[6] See Peek and Rosengren (2005) for more details on evergreening.

most commercial banks in the world must observe a (more or less) universal set of guidelines, as set out in principle by the Bank for International Settlements (BIS). Rules on bad loan provisions are frequently based on national accounting standards and company legislation, as are rules on whether banks are allowed to deal with borrowers in a manner other than at arm's-length. Including these factors will cloud the clarity of the implications for a representative bank. To keep the model simple and the implications clear, other financing decisions, such as the issuance of convertible debt or shareholder capital are also kept out of the model. By doing so, this chapter provides clear insight into the most basic incentives of a bank, that is, how their decisions on NPLs impact on their financial positions, and why some banks may choose to slow down the process of dealing with NPLs.

Since most bank loans are secured by collateral, the disposal of bad loans necessarily involves the repossession and sale of such assets. In Chapter 3, the analysis is extended to look also at the market for assets. As the incidence of NPLs increases in times of downturn, some commentators, such as Chen, Chu, Liu, and Wang (2006), opine that liquidating bad loans and selling collateral must be detrimental to the economy, as it applies further downward pressure to the prices of such assets. This result is obtained without considering the other actions that banks take as they dispose of their bad loans. If the subsequent usage of funds recouped from the sale of collateral is included in the analysis, then the results are less obvious, since the new activity can potentially support asset prices.

This chapter takes a look at this issue by applying the framework in Chapter 2 to include interactions with the market for collateral. Specifically, the model does not limit the interaction to a mechanical firesale of assets, but rather the subsequent usage of recovered funds is also included. At the same time, the application of capital regulation and its effects on collateral prices must also be investigated. This is important because the capital ratio imposes a limit on the amount of risky loans banks can give out, and this can have an impact on the sale of repossessed collateral and hence asset prices. The interaction between banks' disposal of NPLs, its impact

on asset prices, and the constraint imposed by capital regulation gives rise to a complicated set of influences on how banks treat their bad loans. The model shows that if the costs of liquidating bad loans are not too great, then asset prices need not fall as new activity provides support to the market. There is also the possibility that banks may allow forbearance as a rational response. Such nuanced results serve to bring optimal bank behaviour further away from the two extreme opinions mentioned above, and also raises the question of whether capital regulation, as the only thing that policymakers can control in this environment, can be used to manage the banking sector.

Central banks in some industrialised countries have in the last few years engaged in policies beyond normal manipulation of official interest rates to ease the problems with the banking sector. These actions range from capital injection into some banks, to accepting a larger range of bank assets as collateral. The implementation of such policies is based on the belief that bank lending is an important component of economic activity, and that central bank policy is able to influence the banking sector. Regarding the relationship between bank lending and the transmission of monetary policy, Bernanke and Gertler (1995) mention that the bank lending channel affects the economy through altering the amount of bank loans made available by banks. Prior to the 1980s, the Australian banking environment was generally conducive to the bank lending channel to exert a strong influence on how monetary policy was transmitted, because markets for alternative finance were not as well developed and there were more hurdles for participants to enter them. Since then, many changes have opened up the banking sector to outside influences. These changes include a process of deregulation, allowing banks to compete internationally, and in permitting banks to engage in more financing activities both domestically and overseas. Innovations in financial markets have also led to the securitisation of erstwhile illiquid assets. These developments raise the question of whether the strength of the bank lending channel changes over time. The development of the Australian banking sector since the 1980s is explored in

Appendix F.

Chapter 4 is an empirical study to measure the strength of the bank lending channel of monetary policy in Australia. The specific focus is on whether the monetary policy impulses are transmitted through influencing the supply of bank lending to firms, a class of borrowers supposedly better able to access market finance. The estimations in this chapter make use of macroeconomic time series data in Australia to investigate movements of the spread between bank lending and bond rates. Some studies of the bank lending channel, notably Kashyap and Stein (2000), make use of individual bank level balance sheet data to build a panel dataset, since banks of varying sizes and strength may respond to monetary impulses in different ways, and thus the borrowers from these heterogeneous banks are affected differently. This way, the problem of isolating supply side factors of bank loans using equilibrium bank loan volumes data is solved. However, since the Australian banking sector only has a small number of banks, assembling data for such a panel is impracticable as there will not be enough datapoints with which to carry out estimations. Hence, macroeconomic data is used in a different estimation strategy. Because of the small number of banks that dominate the market for commercial lending in Australia, the individual behaviour of the few big banks is representative of the sector as a whole, so the use of aggregate data is loosely representative of activity by industry in general. The theoretical grounding of the model used is based on the Bernanke and Blinder (1988) model, which can be used to see if the potency of the bank lending channel is driven by a number of banking sector aggregates through investigating variations in the spread between interest rates charged on bank loans and bonds.

A separate contribution of this chapter is the addition of Australian evidence to the growing international literature on the bank lending channel. Many countries have had studies done on them, yet only Suzuki (2004) has offered any evidence on Australia. Suzuki's finding that the bank lending channel does not dominate other channels of transmission does not allow a conclusion to be made about the

strength of this channel of transmission. This chapter adds extra information to the Australian case by providing evidence that large and small firms face different circumstances in obtaining bank loans, and in confirmation with Suzuki (2004), foreign funding can reduce the effects of the bank lending channel.

Chapter 5 is the conclusion to the thesis.

Chapter 2

Bank Incentives in the Treatment of Non-Performing Loans

2.1 Introduction

This chapter attempts to investigate the factors that influence a bank's choice when treating non-performing loans (NPLs) on its books, centering on the decision over rollovers and liquidations. One of the most important things banks consider in any lending decision, and by extension in the treatment of NPLs, is how the future outlook of the economy will affect the expected productivity of its borrowers. The prospect of borrowers making adequate profit to make interest payments and repay the principal is an important consideration for a bank. However, economic outlook is not the only factor that determines a bank's response to bad debts. A bank's own health also features prominently in this process and it is manifested in the form of capital adequacy concerns.

In the debate over the treatment of bad loans, suggestions for the banking sector typically centre on how much funds banks should make available to new firms. Two opposing views have either called for zero tolerance of bad loans, which means banks should write them off as quickly as possible, or to allow delinquent borrowers the chance to repay their loans, by asking banks to tolerate the presence of bad loans on their books. For example, in Caballero, Hoshi, and Kashyap (2006), a suggestion

for stimulating the Japanese economy is to get banks to liquidate the loans of bad companies as quickly as possible, because this frees up much needed funds for new and competitive firms. In von Peter (2004), analysis of banking sector intermediation and its effect on asset prices and the macroeconomy assumes NPLs produced by a negative shock to be written off immediately.

The debate over the merits of these two extreme opinions have largely ignored the questions of interest that face banks. There is no consideration of whether banks may choose not to write them off instantly, and what effect that will have on the macroeconomy. While these comments may make good sense from a macroeconomic point of view, and therefore appeal to policymakers and a variety of interest groups, in reality banks by no means only abide by suggestions made on the basis of macroeconomic prospects. Ultimately, commerical banks are companies aiming to make profits, and there is no obligation on them to put the health of the entire economy as first priority. There are a number of private concerns that a bank must attend to.

Two of the most important among them have to do with the viability of a bank. A bank's ultimate objective is to maximise profit, so it is natural that the profit motive features prominently in its decision making. Whether or not a bank chooses to forbear a bad loan may depend on the future prospects of the borrower. Another consideration is problems with capital adequacy when banks write off their bad loans. Bank capital is impaired when NPLs are revealed and written off, so in dealing with such loans a prime concern for banks and regulators is bank viability. When the damage threatens to bring a bank below capital adequacy requirements, it raises the possibility that it will engage in activities that maintain a healthy appearance on the balance sheet, contrary to ordinary for-profit behaviour. This point is investigated in a paper by Peek and Rosengren (2005). They study bank behaviour in Japan relating to the evergreening of bad loans, and find evidence that banks there engaged in forbearance as a measure to give their financial statements an arbitrarily healthy appearance. One of the more interesting points mentioned

in their paper is that throughout the 1990s not only did Japanese banks evergreen loans to non-performing debtors, in the process they also did not provision for delays in collection, pursuant to BIS guidelines. That means the reality of non-collection of funds is completely hidden from the balance sheets of banks. This is very notable because it is an attractive, albeit devious, way of hiding NPLs. In this study, this behaviour is explicitly included in the model, to see the implications that this has on bank behaviour.

Potentially, asset prices are another important factor in a bank's consideration. This is because if banks decide to foreclose on borrowers and seize their collateral, the usual way to recoup funds is to sell this asset. While asset prices are low, selling may depress prices further and generate unsatisfactory liquidation receipts. This can have an adverse impact on bank balance sheets. But in trying to deal with the NPLs that originate from declining asset prices, some commentators suggest that banks have limited options in that liquidation of delinquent borrowers will possibly only yield a very low return.

There is a view counter to the above opinion regarding the effects bank firesales have on asset prices. There are question marks over whether the liquidation of part of a small competitive bank's portfolio of bad loans will really cause noticeable price movements in the asset markets in themselves. It seems at least plausible that slumps in asset prices frequently observed in tandem with adverse economic shocks are not directly caused, or even exacerbated, by banks, as is the main premise behind Chen, Chu, Liu, and Wang (2006).

To illustrate the basic decision-making process of banks clearly, this chapter shall not include any interaction between banks and the collateral markets. Doing so allows one to see clearly how a bank's balance sheet is impacted by decisions on disposing of bad loans. The environment is then analogous to one that focusses on a world where small competitive banks conduct their treatment of NPLs without any endogenous effect from the asset market. The model demonstrates that NPLs can potentially harm the bank's capital position, such that when banks see a possibility

that the damage is serious enough to affect their own stability, they must take special action to protect themselves. This may mean that at that stage banks do not choose actions that adhere to the normal *modus operandi* of profit maximisation any more.

The next section illustrates the setup of the model. In Section 2.3, the choice of a bank facing this trade off is considered. Section 2.4 introduces capital regulation and how it affects a bank's actions. The implications that capital regulation raises for the health of banks are discussed in Section 2.5. Section 2.6 concludes.

2.2 Model

2.2.1 Banks

There is a continuum of identical banks in existence. Banks have a given amount of their own capital, some deposits and a portfolio of loans determined outside the model. Deposits pay no interest, as it does not play any significant role in the analysis. In period -1, loans are given out to firms with identical two-period projects which produce output at the end of every period of operation. In period -1, banks' portfolios consist of loans to P firms with two-period identical projects, plus deposits and capital that amount to d and z respectively. Define the size of each loan to be of fixed value l for each firm. The balance sheet of a bank at the beginning of period 0 is given below:

	Balance sheet	at start of period 0	
Cash	$d+z-Pl$	Deposit	d
Receivables	Pl	Capital	z
	$d+z$		$d+z$

In period 0, banks observe a probability of success π in aggregate for these P projects producing output $y_1 > 0$, otherwise $y_1 = 0$, but neither the bank nor firm

knows whether a specific project will be successful or not while contracting. For regulatory purposes, a minimum capital adequacy ratio (CAR) is set by banking authorities, and the capital ratio is observed at a certain level based on these prior activities. It is assumed that banks in this model will not engage in behaviour that intentionally breaches the CAR regulation.

At this point, production outcomes are realised and a proportion $1 - \pi$ of firms, say N, randomly fail to produce anything. They are not able to pay their interest and these loans are defined as non-performing in this model. Banks have to decide whether to continue financing those projects or to liquidate them. The cash available from loan interest and liquidation proceeds will be lent out to finance other projects operated by new one-period firms at the end of the period. The capital ratio of the bank for this period is measured after all actions have been completed. Period 0 then ends.

In period 1, all firms that have ongoing projects realise their output and banks collect interest plus principal. The model ends.

2.2.2 Firms

Each firm is endowed with some level of capital. There are two types of firms. Of the two types, P firms have ex-ante identical two-period projects already in operation while others have one-period projects ready to start in period 0. All firms each invest their endowment $\tilde{k}$ into it and must borrow from banks to purchase the necessary productive assets. They pledge their productive assets as collateral to the banks. The loan contracts last for the same number of periods as the duration of their projects. For the P two-period firms, their loan contracts require them to make two interest payments, i_0 now and i_1 plus principal in period 1.[1] One period

[1] This model abstracts from issues of willingness to pay, by assuming that firms will pay back their loans if their project returns allow them to do so. See, for example, Hellwig (1977) and Eaton and Gersovitz (1981) for analyses of loan markets in which debtors may strategically choose not to repay.

firms pay their interest i_1 in period 1. Interest on the loans is paid after outputs are realised each period. The principal is repaid from output after projects are completed.

In period 0, production outcomes are realised and N firms fail to produce. They are unable to pay interest, and to continue operating next period, they must ask banks to roll over their loans, promising to pay interest for both periods and principal in period 1. Those that are refused rollovers will shut down and exit the economy. Firms (performing or not) are assumed unable to liquidate their assets and close down strategically.

For the $P - N$ performing projects, they pay their interest promptly. Their returns for the next period are independent of the success of the current period. For simplicity, assume it has a probability π of producing $y_1 > 0$ in period 1.

2.2.3 Decision on liquidating NPLs

Given the structure of the model, in period 0 banks must decide between staying with the delinquent firms and continue to finance them, or to liquidate them, sell their collateral, and lend the funds to new firms. To simplify matters, the model only allows banks to take one of two extreme positions:[2]

(1) Rollover the loans, in which case the projects continue. The bank collects nothing in period 0 and attempts to collect both interest payments plus principal next period. Non-performing projects operate at a reduced level of productivity, reflected in a lower probability of success θ, $0 < \theta < \pi < 1$.

[2] There is a spectrum of actions available for banks in between these two extremes. For example, rollovers can take the form of debt restructuring, which may involve paying a smaller amount at a later date. Alternatively, liquidation can also be partial, in which case the banks do not close down the firm in trouble but rather seize only some of its assets. Analysing these in-between cases, however, introduces unnecessary algebra and does not enrich the qualitative results of the model.

(2) Liquidate the firms, in which case the banks recoup some funds by selling the seized collateral. That money is then used for alternative investment.[3] Similar to existing firms, these new firms also invest their endowment $\tilde{k}$ into the projects. The loan size to each new firm is assumed to be the same as the ongoing projects at l each and attract interest at rate i_1. These new firms also have a probability π of producing $y_1 > 0$ and $y_1 = 0$ otherwise.

The assumption of lower productivity for firms that are behind in their loan repayments is based on widespread observations that less dynamic firms tend to be less profitable, and over time they reveal themselves through non-repayment. Also, sometimes firms that are in financial trouble may have to engage in actions that may compromise their future profitability, such as selling off valuable productive assets. Firms that are close to bankruptcy may even have increased attempts by staff to siphon resources away for private gain. In this model, these observations are represented by having a lower level of productivity θ once a firm is behind in repayments.

Define a variable M to be the number of firms among N that is liquidated, $0 \leqslant M \leqslant N$. Should the bank decide to liquidate an incumbent project, the total receipt of the liquidation process for the bank is equal to proceeds from the seizure and sale of assets. The liquidation process is costly and banks are not able to recoup the full amount of the principal.[4] Since the size of each bank is very small, a bank's sale of its assets into the market does not produce a feedback effect. That is, the quantity of assets sold is not substantial enough to change prices in the asset market. Therefore, when a project fails, it is assumed that liquidating the project

[3] There are arguments over what the return of a typical 'alternative investment' is compared to an incumbent non-performing one. Some authors argue that new firms have better productivity, and hence produce better returns than the existing delinquent firms. Corbett and Mitchell (2000) suggest that banks that roll over loans are frequently engaging in 'gambling for resurrection', regardless of the chance that it will result in lower expected net worth for itself. Mitchell (2001) argues that asset dissipation by firm managers, particularly in bad firms, can lead to lower continuation values in rolled over firms.

[4] This can be due to various reasons, for example costs in assessing the value of the firm, in line with the costly state verification literature, legal costs of the bankruptcy process, or losses from selling assets at unfavourable prices.

will result in only $l(1-c)$, $1 > c > 0$ in funds in the same period. The term c is constant and is defined as the loss from liquidation. So for a project of size l, liquidation results in a loss of cl.

In the same period, the bank lends out the recouped funds to new firms. An important assumption made in this model is that, with regard to the inflow of funds from interest income, as much of it as allowed by the capital adequacy regulation is lent out. The size of loans to new projects is assumed to be l for simplicity.

2.3 Bank action

To look at the action a bank takes given the occurence of bad loans, comparison must be made between the expected payoffs for period 1 of both the rollover and liquidation options of the bank's decision. The bank faces a choice over how many projects to close down because liquidation incurs a cost that has to be written off, while rolling over a troubled loan means allowing a project to be run at low productivity but without write-off.

Note that in this model, because there is no feedback effect from collateral price that can affect the initial decision of the bank, the decision of the bank rests solely on the relative attractiveness of the rollover and liquidation actions. Should rollover prove to have a higher expected return, then the bank should roll over all its problem loans, while if the liquidation and new funds branches offer higher returns, then the decision should be to liquidate as many loans as possible.

The total expected payoff for performing projects in period 0 is equal to its probability weighted return. It includes an interest payment $i_1 l$ and principal l. There are $(P-N)$ firms involved in this branch so the total expected receipt is:

$$(P-N)\pi(1+i_1)l.$$

The total expected payoff for period 1 rollover action consists of the probability weighted returns from the project that includes both interest payments and the principal. If the project succeeds the cash receipt in period 1 is greater than a normal performing project. There are $N - M$ projects involved in this branch, with rate of success θ. The payoff is equal to:

$$(N - M)\theta(1 + i_0 + i_1)l.$$

If the draw in period 1 is 'Bad', then the firm produces a project return of 0, and so it drops out of the above equation.

The payoff for liquidation for a bank stems from lending out all available cash. This includes the recouped cash from selling collateral and the interim interest payments from performing firms. In total M projects are liquidated. Since the model assumes there to be no asset price feedback into the banking system, the disposal of collateral results in a fixed amount of recouped funds equal to $Ml(1-c)$ in cash. These funds are then lent out to new firms, with projects that face a probability π of making a profit. The total expected payoff is:

$$Ml(1 - c)\pi(1 + i_1).$$

There is also the expected return from lending out the inflow of interest income. These funds are paid in by the $(P - N)$ firms that pay on time. In period 0, they each pay an amount of $i_0 l$ in interest. Similiar to above, these funds also go to new projects and have chance π of success. The expected payoff to lending made from these funds is:

$$(P - N)i_0 l\pi(1 + i_1).$$

So in period 0 the total expected payoff (TEP) that faces the bank when it has to make a decision of liquidation is a simple addition of the four branches.

2.3.1 Profit maximisation without capital regulation

Since in this model the amount of recouped funds from liquidation is fixed, and the entire amount of funds recouped from liquidation is lent out, the expected payoff of making such loans can be determined simply by looking at the amount of liquidation M. As there is no capital regulation, a bank's action depends solely on its cash flow position. The simple setup of the model leads to the intuitive result that the decision between rollover and liquidation is a binary choice between liquidating all bad loans if it is more attractive to do so, or to rollover all of them if otherwise. This intuition means that there are only two corner solutions: either optimal liquidation $M_{CF} = 0$ if it is more attactive to rollover the bad loans, or $M_{CF} = N$ if it is better to liquidate. Representing the discount rate of this economy by R, this choice can be demonstrated as maximising the total expected payoff (TEP) function:

$$\begin{aligned}\max_M TEP &= \frac{1}{R}[(P-N)\pi(1+i_1)l + (N-M)\theta(1+i_0+i_1)l \\ &\quad + Ml(1-c)\pi(1+i_1) + (P-N)i_0 l\pi(1+i_1)]. \qquad (2.1)\end{aligned}$$

Differentiating TEP with respect to M, the condition that governs this choice of action is

$$\theta(1+i_0+i_1) = (1-c)\pi(1+i_1). \qquad (2.2)$$

This condition simply states that a bank is indifferent between rollover and liquidation if the return to both actions are the same. Should $\theta(1+i_0+i_1) > (1-c)\pi(1+i_1)$ then the bank will rollover all bad loans. The reverse is true if $\theta(1+i_0+i_1) < (1-c)\pi(1+i_1)$.

2.4 Capital Adequacy Ratio (CAR)

Officially the CAR is equal to: (Tier 1 + Tier 2 Capital)/Risk-weighted assets and fluctuates between 0 to 1. The regulation set by the Bank for International

Settlements for the minimum ratio is 8% of total risk-weighted assets. It is a rule that concerns the financial position of a bank, as opposed to its cash flow situation. As discussed in Barth, Caprio Jr., and Levine (2006), the Basel II guidelines consist of four approaches for calculating the capital ratio, some of which are very complex due to their reliance on internal ratings-based models. But the spirit of these methods is the same as the simple standardised approach, which will be used in this chapter. For details of these approaches, see Basel Committee on Banking Supervision (2006).

In this model the regulatory minimum is the lowest level that banks' capital ratio can be. They will never conduct operations if it is already below the minimum regulated level, nor will they engage in conduct that brings their capital ratio to below it.[5] Define variable $\underline{CR}$ as the required level of capital adequacy.

To compute the capital ratio of a bank, it is helpful to build the balance sheet at different points in time, so that all the actions that may affect the capital ratio can be clearly listed. Recall the balance sheet of a bank at the start of period 0, before it takes action with its NPLs:

	Balance sheet	at start of period 0	
Cash	$d+z-Pl$	Deposit	d
Receivables	Pl	Capital	z
	$d+z$		$d+z$

At the start of the model, a bank's balance sheet contains capital in cash to the size of z and deposits d, so the bank has $d+z$ in cash with which to lend out. As described above, the bank lends l each to P firms, so the amount of accounts receivables is Pl. Now define $\widetilde{CR}$ as the capital ratio of the bank at this point. Using the simple approach in Basel II, and assuming that all loans are risk weighted

[5] Commonly below this level banks are viewed as unsafe by prudential authorities. Usually action will be taken to either take control of the bank (to nationalise it) or other measures will be implemented such that the interests of depositors are safeguarded. This may include closing down the bank, or bailing it out while changing its management.

at 100% for simplicity,[6] this bank's capital ratio is equal to capital over receivables:

$$\widetilde{CR} = \frac{z}{Pl}.$$

A profit-maximising bank in this model will choose to lend out all funds allowed by the constraints on cash and capital adequacy. A typical bank's capital ratio is hence just high enough to satisfy the minimum $\underline{CR}$.

In period 0, both the numerator and the denominator of the CAR change if there are write-offs of NPLs or collections of cash. Recall that interest on deposits is normalised to 0. The four events that happen in this period 0 have already been mentioned in section 2.3. Their effects on the capital ratio are detailed below:

1) The $P - N$ performing projects pay interim interest $(P - N)i_0 l$ in total. This is income for the banks and enters the balance sheet as retained profits under capital. That means it enters the numerator of the capital ratio. *Ceteris paribus*, the capital ratio rises.

2) $N - M$ non-performing projects are rolled over. Since the non-recognition of problem loans means no provision or expense is made to the accounts, there is no change to the capital ratio. Recall that this chapter explicitly models the phenomenon of problem loans not being revealed to the public. They remain hidden as opposed to the BIS regulation that loans sufficiently long past due date attracts a higher risk weight in the capital ratio. If done in accordance with the rules, the capital ratio should have in its denominator an extra charge equal to a percentage of the NPLs, say $\eta(N - M)l$, $0 < \eta < 1$, as deemed appropriate by the authorities. The capital ratio will then drop as a result.

3) M projects out of those N non-performing ones are liquidated. The bank recoups $l(1 - c)$ per project from selling collateral. On the balance sheet, an

[6] Under BIS guidelines, except under some strictly defined benign circumstances in commercial property markets, commercial property carries a 100% risk weight. See paragraph 74 in Basel Committee on Banking Supervision (2006). Given the assets in this model are used in production, it is appropriate to consider them as commercial property for calculating the capital ratio.

amount Ml of loans is written off, but $Ml(1-c)$ is recouped so the net write-off is equal to Mlc. Capital in the numerator therefore drops by Mlc, receivables in the denominator drops by Ml. The effect this has on the capital ratio CR_1 depends on the size of the loss c.[7]

4) The bank, after having collected cash from events (1) and (3), then lends the funds to new firms, as far as allowed by the constraint on CAR. Such new lending includes two components. Their effects of the capital ratio are:

a) liquidation receipts of up to $Ml(1-c)$ can be lent out. That becomes new risky lending and enters the denominator of the capital ratio. The ratio drops.

b) new loans equal to $(P-N)i_0 l$ can be given from interest income from point (1). The capitlal ratio drops.

A note needs to be made on the fluctuation of the capital ratio with regard to liquidation and subsequent lending. Recall that in this model it is assumed that, subject to constraint, all funds from liquidation, $Ml(1-c)$, will be lent out immediately. That means they remain as risky assets. So even if the loss from liquidation, c, is low enough to allow the capital ratio to rise after the asset sale, the actual ratio at the end of the period will still decline.[8]

The balance sheet at the end of period 0 can be constructed as follows:

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[7] Specifically, given that in period 0 banks will lend until CR_0 is lowered to $\underline{CR}$, if c is large enough such that the liquidation recoups less than a fraction $1-\underline{CR}$ of the loan, then CR_1 will drop. Otherwise it will improve.

[8] In that sense, the operation of a bank here is different to a typical 'balance sheet shrinking' exercise, where new loans are not given out after liquidation so that the capital ratio improves.

Balance sheet at the end of period 0

Cash	$d+z-Pl+(P-N)i_0l$	Deposits	d
	$+Ml(1-c)-(P-N)i_0l$		
	$-Ml(1-c)$		
Receivables	$Pl-Ml+(P-N)i_0l$	Capital	$z+(P-N)i_0l$
	$+Ml(1-c)$		$-Mlc$
$d+z$	$+(P-N)i_0l-Mlc$	$d+z+$	$(P-N)i_0l-Mlc$

Denote the capital ratio at this point in time as CR_0. With the balance sheet above, this can be computed as:

$$CR_0 = \frac{z+(P-N)i_0l-Mlc}{Pl+(P-N)i_0l-Mlc}.$$

Expressed in terms of $\underline{CR}$, the CAR constraint in period 0 becomes

$$\frac{z+(P-N)i_0l-Mlc}{Pl+(P-N)i_0l-Mlc} \geqslant \underline{CR}. \tag{2.3}$$

This equation shows that to improve the capital ratio, the simplest and best method is to increase the amount of capital. In this model, interest income $(P-N)i_0l$ collected in period 0 is immediately lent out as new loans, which increases risky assets. Even so, when there is more interest income, the ratio will still improve. Note that the amount of interest income is directly dependent on the number of delinquent firms N, so a smaller N is associated with a higher capital ratio. As well, the term Mlc represents the loss upon writing off bad loans and selling off the collateral. If this term is positive, then the capital ratio declines. When that is the case, even though writing off bad loans reduces receivables (which is counted in the denominator), capital is impaired even more in the process. See also point (3) above.

Given that the CAR requirement is a positive number between 0 and 1, denoted

by $\underline{CR}$, and the attractiveness of engaging in as much lending as possible, banks will lend out all its funds until $CR_0 = \underline{CR}$.

2.4.1 Profit maximisation with capital regulation

As mentioned, the capital ratio is a regulation that affects the financial position of a bank, with only passing regard to its cash flow position. Therefore, there is no reason why capital regulation must become a constraint on bank activity in the same way as its cash flow. The minimum capital ratio can become a constraint on bank activity with respect to liquidating NPLs only if it is stringent enough. When that is the case, the capital ratio expression derived above imposes a limit on how much a bank can liquidate its bad loans.

Since the total expected payoff for a bank is still the same as when there is no capital regulation, the TEP function remains the same as equation (2.1). Notice that even with capital regulation in place, the bank's problem remains a binary choice of either rolling over all NPLs, or liquidating as much as allowed by the minimum capital ratio. Subject to the amount of liquidation being between 0 and N, the maximum level of liquidation can be worked out from the CAR constarint equation (2.3). If the marginal payoff to liquidation is more attractive, then a bank will liquidate as much as allowed, so by setting the binding CAR constraint as an equality

$$\frac{z + (P - N)i_0 l - Mlc}{Pl + (P - N)i_0 l - Mlc} = \underline{CR},$$

the maximum level of liquidation M_{CAR} is:

$$M_{CAR} = \frac{z - \underline{CR}Pl + (1 - \underline{CR})(P - N)i_o l}{cl(1 - \underline{CR})}, \tag{2.4}$$

subject to $0 < M_{CAR} < N$.

The above expression implies that higher capital, interest income or lower liquidation cost will raise the maximum level of liquidation allowed under a non-zero CAR regulation.

2.5 Bank health and behaviour in liquidating bad loans

An important question that demands consideration over a bank's liquidation action of bad loans is whether the bank is able to liquidate an appropriate amount given its expected payoff. When a negative shock that results in NPLs happens, banks will try to liquidate as much as profit maximisation prescribes. But if the CAR constraint binds the bank to a maximum amount of liquidation below what profit maximisation asks for, then some evergreening of bad loans due to worsening bank health will happen. The bank's expected profits decline as a result. When banks are forced by considerations of their own health into evergreening, forbearance rises to above the level permitted by unconstrained profit maximisation.

The above situation of health-induced forbearance will arise if M_{CF}, the amount of liquidation without capital regulation, is higher than the M_{CAR}. Recall that when not constrained by CAR regulation, and liquidation provides better expected return, then $M_{CF} = N$. So $M_{CF} - M_{CAR} > 0$ is equal to N minus expression (2.4). It results in the following condition:

$$N > \frac{z - Pl[\underline{CR}(1 + i_0) - i_0]}{(1 - \underline{CR})(c - i_0)l}$$

As long as the above expression holds, banks are prevented from liquidating as much as they wish to, and must forbear some bad loans. To interpret the above expression, note that the magnitude of the adverse shock which N represents directly influences the capital ratio by affecting how many performing projects pay interest. It also determines how much liquidation should be when there is no CAR constraint. Under the CAR constraint, the maximum liquidation amount M_{CAR} may be below $M_{CF} = N$, the unconstrained amount, because liquidating too much will drive the capital ratio below $\underline{CR}$. If N is too large (which means M_{CF} is too large), then the decline in capital ratio will be too large for banks to write off all bad loans.

By setting $M_{CF} - M_{CAR} = 0$, it is possible to look at the value of loan interest rate i_0 charged in period 1 that can compensate for losses from liquidation such that the CAR constraint does not bind, in which case banks are free to maximise profit. In other words, when loan rates reach this level, banks are free to liquidate all the bad loans on their books, which will guarantee maximum profit. Denote this interest rate as $\bar{i}_0$. This expression is:

$$\bar{i}_0 = \frac{Ncl(1 - \underline{CR}) + \underline{CR}Pl - z}{(1 - \underline{CR})(P - N)l}. \tag{2.5}$$

Unsurprisingly, this level of interest is positively related to the size of the NPL shock N, the cost of liquidation c and also the minimum capital requirement $\underline{CR}$. These three parameters impose costs that bring banks closer to the regulatory minimum, so a higher level of interest income is needed to cover for it. This rate is also negatively related to capital z, meaning that well capitalised banks can afford to charge lower interest on loans without the CAR constraint binding. If i_0 rises above this level, then the CAR constraint will not bind.

The implications discussed above concur with Peek and Rosengren (2005), that there is incentive for banks which have capital ratios close to the BIS minimum to engage in forbearance lending, out of protection of their own balance sheet. In the case of Japan, it has been documented that in the 1980s Japanese banks in general had low capital ratios.[9] In the 1990s, the negative productivity shock accompanied by slumping asset prices led the Bank of Japan to drastically lower interest rates. In the model, this will suggest that loan interest rates in Japan in the 1990s are unlikely to be high enough to cover banks' loan losses such that the CAR would not present a problem. It also rules out the possibility of using a 'fat spread' strategy to restore bank profitability.[10] The model thus points to forbearance lending as a

[9] For example, Singer (2004) quotes the capital ratios of Citicorp and Barclays in 1986 to be 4.73% and 4.71% respectively. In the same year, that of Dai-Ichi Kangyo, Sumitomo and Fuji were 2.38%, 2.89% and 2.95%.

[10] In the simple environment of this model, with identical banks in a competitive market, it is difficult to envisage any bank raising margins to compensate for write-offs. However, it was used in the US during the Savings and Loans crisis in the late 1980s. See Koo (2003). The

reasonable response.

Note that following events in Japan at that time, this model is constructed explicitly with no consequence for the capital ratio if it rolls over bad loans, contrary to BIS guidelines.[11] It means that there is no need for provisioning for bad loans which will lower the capital ratio. Authorities which allow this to happen essentially serve to relax the binding CAR constraint. If it had not been allowed in Japan, it would have led to even more forbearance lending. This is particularly in line with what is described in Peek and Rosengren (2005) as 'balance sheet cosmetics', that it is the appearance of health that matters most for these banks. Shimizu (2007) describes how these kinds of discretionary changes to interpreting the BIS capital ratio have resulted in these published ratios losing its use as a proxy for bank safety. Instead, there is evidence that return on assets is a better predictor of bank health. Given the NPLs on banks' books, this is very sensible due to the aging of outstanding account receivables.

This model is also in broad agreement with papers that suggest capital ratio requirements to be procyclical. For example, in Kashyap and Stein (2004), BIS regulations limit bank lending in downturns due to the lower ratings given to good loans, and also losses from defaults which worsen the capital ratio. In Furfine (2001), it is the flight to holding safe government securities in bad times that leads to lower commercial lending. There is no alternative security or mechanism for rating loans in this model, but the same result is arrived at through bank health-induced forbearance lending. Due to an upper limit on liquidation imposed by the CAR, the amount of funds freed up for new lending is effectively capped compared to the unconstrained case. However if there is less liquidation more funds will remain with the non-performing incumbents.

This chapter also highlights another feature of bank behaviour, that forbear-

'fat spread' strategy refers to authorities allowing bank loan rates to be much higher than official interest rates, giving banks extra profits so that they can afford to write off their bad loans.

[11] Today, officially, loans unpaid for more than 90 days after their due dates must be recognised and their risk weightings increased. See paragraphs 75-78 in Basel Committee on Banking Supervision (2006).

ance lending can arise as a concern of a bank's own health. Notice that essentially $M_{CF} - M_{CAR}$ is equal to the incidence of bank health-induced forbearance. Importantly, this behaviour is forced upon banks and reduces profits. This amount of forbearance is different from forbearing loans out of profit maximisation. In this simple model, there is no feedback effect from liquidation and so the optimal action without the CAR constraint does not entail rolling over some of the bad loans. But in environments with richer dynamics, rollover is a common phenomenon as in reality.[12] Therefore there are two types of forbearance that banks may engage in, one stemming from profit maximisation and another from safety concerns. It can be said that the higher the latter figure is, the further away bank policy is from being able to clear NPLs from its books.

Aside from the obvious use of limiting bank exposure to risk, another important question often asked about capital regulation is what impact it will have on banks of varying health, since banks in the real world differ in their capital positions. The effect on the amount of bank health-induced forbearance due to a change in prudential regulation requirements (change in CAR) can be found by computing the derivative of equation (2.4). The derivative is:

$$\frac{\partial M_{CAR}}{\partial \underline{CR}} = \frac{z - Pl}{cl(1 - \underline{CR})^2}. \tag{2.6}$$

One can see the sign of this expression depends on the magnitude of $z - Pl$. By appealling to the balance sheet at the start of period 0 in section (2.4), three scenarios can result.

Case 1: Initially, a bank holds just enough capital to satisfy capital regulation. That means the capital ratio of this bank is $\underline{CR} = \frac{z}{Pl} < 1$, that is, $z = \underline{CR}Pl$. Substitution yields:

$$\frac{\partial M_{CAR}}{\partial \underline{CR}} = -\frac{Pl(1 - \underline{CR})}{cl(1 - \underline{CR})^2} = -\frac{P}{c(1 - \underline{CR})} < 0.$$

[12] See for example Chen, Chu, Liu, and Wang (2006) and Kobayashi, Saita, and Sekine (2002).

Being strictly negative, it means that for banks that barely pass the CAR minimum, supposedly the most unhealthy among those allowed to operate, tightening capital regulation will lead to less liquidation (that is, more forbearance).

Case 2: For most healthier banks that hold more capital than the regulated minimum, $\underline{CR} < \widetilde{CR} = \frac{z}{Pl} < 1$. Compared to *Case 1*, capital is now more plentiful relative to risky loans. Substituting into the derivative expression (2.6) above results in:

$$\frac{\partial M_{CAR}}{\partial \underline{CR}} = -\frac{Pl(1-\widetilde{CR})}{cl(1-\underline{CR})^2} < 0.$$

Here, because $\underline{CR} < \widetilde{CR}$, the absolute value of the derivative $\left|\frac{\partial M_{CAR}}{\partial \underline{CR}}\right|$ will be smaller than in *Case 1*. But since the derivative is also strictly negative here, it means that for this group of banks, the response of maximum liquidation M_{CAR} to a tightening in capital regulation is also to reduce liquidation (again, more forbearance), but the impact is more muted. This point is also demonstrated by the result

$$\frac{\partial M_{CAR}}{\partial \underline{CR} \partial z} = \frac{1}{cl(1-\underline{CR})^2} > 0.$$

Notice the positive expression for $\frac{\partial M_{CAR}}{\partial \underline{CR} \partial z}$ means that if banks hold more capital initially, then it mitigates somewhat the drop in maximum liquidation allowed due to tightening capital regulation.

Case 3: If a bank holds so much capital (or makes so few loans) that it covers all risky assets, then it does not have to rely on deposits to make new loans. In this model, it is reflected by the condition $\underline{CR} < 1 < \widetilde{CR} = \frac{z}{Pl}$. This implies $z > Pl$ and hence $\frac{\partial M_{CAR}}{\partial \underline{CR}} > 0$. However, under such a circumstance, capital regulation is redundant since even non-repayment of all loans will still not exhaust available capital.

From the evidence above, it can be concluded that when the CAR requirement rises, the maximum amount of lending as well as liquidation are reduced (except

for banks that do not have to rely on deposits to give loans). Thus if the CAR minimum requirement is raised in period 0, it will result in banks having to make fewer new loans, and liquidate less, thus going further away from the optimal amount of liquidation. Conversely, if banking authorities lower the CAR requirement in response to the negative shock, then it allows more room for banks to liquidate delinquent borrowers, the incidence of forbearance decreases, and it will bring the bank closer to profit maximisation. New loans to new firms will also increase.

The same analysis can be carried out to look at how different levels of liquidation cost c will impact on maximum liquidation when capital regulation changes occur. The second derivative with respect to c is

$$\frac{\partial M_{CAR}}{\partial \underline{CR} \partial c} = -\frac{z - Pl}{c^2 l(1 - \underline{CR})^2}.$$

Again, the sign depends on the relative magnitude of z and Pl. The corresponding results for *Cases 1* and *2* above (where $z < Pl$) are both positive: $\frac{\partial M_{CAR}}{\partial \underline{CR} \partial c} = \frac{P(1-\underline{CR})}{c^2(1-\underline{CR})^2}$ and $\frac{P(1-\widetilde{CR})}{c^2(1-\underline{CR})^2}$ respectively. That means when banks face high liquidation costs, the change in maximum liquidation allowed per unit change in capital regulation is smaller. This is most likely because with high liquidation costs, the amount banks can liquidate is smaller anyway, so forbearance due to bank health will not be affected heavily.

Interestingly, the amount of interest income does not affect the rate of change in maximum liquidation when capital regulation changes, as $\frac{\partial M_{CAR}}{\partial \underline{CR} \partial i_0} = 0$.

To sum up, if varying capital regulations is to be used as a policy lever, then banks that hold more capital will face less of an impact to the extent that the amount of bad loans they can liquidate will drop by a smaller amount. Also, higher liquidation costs in general, which represent losses incurred in the process of winding up bad loans, lead to a smaller impact on maximum liquidation, because banks will be liquidating less anyway. Importantly, given that $\frac{\partial M_{CAR}}{\partial \underline{CR} \partial c} > 0$ for both

Cases 1 and *2* above, with $\underline{CR} < \widetilde{CR}$ the expression for *Case 2* ($\frac{P(1-\widetilde{CR})}{c^2(1-\underline{CR})^2}$) is smaller in absolute value. That means as banks face higher liquidation costs, those that hold more capital (*Case 2*) will still face a smaller bite when capital regulation is tightened. This latter finding is significant because weak economies tend to have a combination of banks with low capital ratios and higher liquidation costs (or lower recoupment receipts). If higher capital regulation is implemented at such a time, as is intended with Basel III, then authorities must be alert to the large impact this policy will have on the weaker banks.

Overall, in this model, given that banks are price takers on collateral markets, the consideration over liquidation is limited to the polar opposites of liquidating all bad loans or forbearing all of them. The crucial point of the decision depends on the expected productivities that banks face on the new and rolled-over projects. The role the CAR regulation plays in banks' decisions is to place a limit on the maximum amount of liquidation possible should the bank decide to liquidate at all. This limit, however, can be alleviated by higher loan interest rates or more capital. Forbearance lending in this model is the result of sub-optimal profit maximisation.

2.6 Conclusion

This chapter has shown that in the absence of collateral price considerations, bank policy in dealing with NPLs is crucially dependent on two factors that can affect a bank's viability as a going concern: the relative future productivities of good versus non-performing projects and a possibly binding capital adequacy constraint. This outcome differs from opinions expressed by the media and regulators about writing off bad loans quickly or slowly. The reason is because these opinions are generally made only with preserving the macroeconomy in mind.

For banks, the forbearance of NPLs can be a natural occurence in the process of profit maximisation, but it can also be a result of banks not being able to liquidate

their delinquent loans due to the damage it will do to their own health. In that sense, unsubstantiated calls for banks to write off their bad loans as quickly as possible to provide stimulus to the macroeconomy may not generate desired results. It will serve to hurt the returns of banks through reduced bank stability as capital is impaired.

The occurence of large negative shocks means banks are more likely to be prevented from liquidating their NPLs by the capital adequacy requirements. A change in the regulatory capital ratios will also serve to change the liquidation behaviour of the banks. A lowering of the regulatory minimum is shown to induce banks to liquidate more, meaning they have a chance to go closer to maximising profit. An increase in the minimum ratio is seen to encourage more forbearance.

It is shown that for banks that have higher levels of capital adequacy, the amount of extra forbearnace that must be borne when capital regulations are tightened is smaller. It implies that they are less likely to be hurtfully constrained by capital regulation. Also, in environments where costs to liquidation can be high, healthier banks with more capital need to forbear less extra bad loans compared to those that barely satisfy the capital adequacy ratio. These results hint at less healthy banks being much more affected by changes in capital regulation.

The environment in this model is very simple in that there is no feedback from asset prices affecting banks' profitability, and also that banks can always lend out all the funds recouped from liquidation. Events in several countries in the past have shown that it need not be the case. Asset prices can be a major consideration for a bank, particularly since negative productivity shocks tend to be accompanied by asset price decline, and in some cases also a general lack of demand for bank loans. These factors have the potential to bear heavily on bank policy. Their effects are left for the next chapter.

Chapter 3

Liquidation, Asset Prices and the Recycling Channel of Bank Lending

3.1 Introduction

The behaviour of banks in treating their non-performing loans (NPLs) is frequently debated in the press, particularly close to or during economic downturns as NPLs become more of a concern. In such debates banks are often criticised for contributing to reducing economic activity in foreclosing on troubled borrowers and their subsequent sale of collateral depessing to asset markets. They are sometimes even implicated as culprits for increased unemployment and criminal activity. This kind of opinion can be seen from the US government's plan in late 2007 to stop banks from foreclosing on some subprime mortgages. In a press statement, then Secretary of the Treasury Henry Paulson said[1]

> Homes in foreclosure can pose costs for whole neighborhoods, as crime goes up and property values decline. Avoiding preventable foreclosures, then, is in the interest of all homeowners.

[1] U.S. Treasury (2007), 3rd December.

The thrust of this plan is to reduce the magnitude of any firesale of repossessed homes by imposing a five-year rate freeze on some subprime mortgages and also opening up new ways of refinancing some others.

The argument behind the above plan is that a side effect brought about by banks liquidating NPLs is the adverse impact it has on asset markets. By selling repossesed collateral, they add to the supply in what sometimes can be an already depressed market. This is the view suggested by Minsky (1982), who looks at the damaging effects of such sale of assets on the financial system and Shim and von Peter (2007) who study how distress selling of assets can produce feedback loops that further burden the asset market.

This is one of the reasons for authorities to slow the process of liquidating such loans, for fear falls in asset prices can generate undesirable effects in the economy. The discussions of Peek and Rosengren (2005), Cargill, Hutchison, and Itō (1997) and Tett (2003) suggest the resultant macroeconomic instability as a reason why banks in Japan may have faced pressure from the government to evergreen more in the 1990s. In turn, this downward pressure on asset prices is considered a reason why banks should engage in forbearance on their own accord in the first place.[2]

But the story above is somewhat incomplete if it neglects the fact that banks do try where possible to make new loans. To gauge the overall effect of treatment of NPLs by the banking sector, the increase in the supply of collateral must be considered together with banks recycling the funds received into new bank loans. Changes in risk appetite notwithstanding, banks which only hold onto the cash must pay an opportunity cost, and without other compelling reasons, doing so means they are then not maximising profits. Studies which consider collateral prices, for example Chen, Chu, Liu, and Wang (2006) and Shim and von Peter (2007), focus on exploring the nexus between liquidation and falls in asset prices, such as

[2] See for example Kobayashi, Saita, and Sekine (2002) who suggest the reason why banks may not terminate bad projects is because liquidation prices can be too low, and the uncertainty over whether new projects are good or bad.

whether liquidation stops at some point or if they reinforce each other. They do not consider the effect of banks making new loans from liquidation proceeds. In these environments, the economy does not have any new borrowers after liquidation takes place. That means recouped funds from repossessed collateral cannot be recycled and no new loan can be given.

This chapter aims to study a bank's decision on clearing NPLs while taking explicit notice of the recycling of liquidated funds into new lending, and their impact on asset markets. The literature relating to liquidation and collateral markets, including Chen, Chu, Liu, and Wang (2006), is usually based on the modelling arrangements of Hart and Moore (1994) and Kiyotaki and Moore (1997b), which typically specify the ownership structure of collateral by entrepreneurs and the borrowing that can be obtained from identical banks based on such assets. The amount of borrowing, and hence investment, is limited by the value of the collateral pledged, since entrepreneurs have specific skills related to their projects and face a credibility problem when they promise to pay by not running away. In such a scenario, a shock to the productivity of the asset which leads their prices to drop will cause future bank borrowing to drop in tandem. The advantage of this setup is that it offers a simple mechanism to consider how collateral values affect entrepreneurs intertemporally, and alternatively, what sort of impact does bank liquidation have on asset prices and future investment.

Within such a setup, Chen, Chu, Liu, and Wang (2006) extend the model by allowing firms to fail, in which case banks either liquidate and seize their collateral, or forbear the loans to keep the firms alive, and ask how much forbearance banks will allow given the relationship between liquidation and collateral prices. Yet by concentrating on the current period only, their model is compelled to produce falls in asset prices whenever there is liquidation and therefore overly strengthens the case for evergreening bad loans. A slight moderation of the model employed in their paper will introduce a different outcome and show why it is important to consider the impact of new bank loans made. By specifically including lending to new firms,

there is a channel for new demand for assets which will hence lessen the detrimental impact of liquidation on markets. The power of such new loans in stimulating the economy is demonstrated in a study of bank failures during the Great Depression in Anari, Kolari, and Mason (2005). They study the speed with which deposits in failed banks are released by administrators to depositors and its effect on the US economy. The average speed of six years was found to prolong the Great Depression by not allowing depositors to channel their monies into consumption or investment. They suggest banking distress lasted as long as ten years because of this slow release of deposits. While they do not study bank loans *per se*, the positive effects of recycling funds into the economy is clear.

There are a number of studies that focus on the dynamic effects of shocks on asset markets and the economy in general. One type of study centres on the propagation through changes in investment that often leads to magnification of what is originally a small disturbance and produces widespread consequences for other sectors. A number of studies, such as Carlstrom and Fuerst (1997), Kiyotaki and Moore (1997b), and Chen (2001), among others, have documented various mechanisms through which different shocks can transmit through the economy. A different literature, for example, Kiyotaki and Moore (1997a), Cunat (2004), and Boissay (2006) documents how terminated borrowers will default on their creditors, and in turn put them in difficulty, thus creating chains of default which can also propagate through the economy. These papers concentrate on the consequences of aggregate shocks, and while they highlight how shocks can start off a series of events, their main focus is not on the reactions of the financial intermediaries themselves. For example, Kiyotaki and Moore (1997b) only refer to an aggregate productivity shock which triggers the propagation, without identifying the exact mechanism from which it is created. While the asset price fluctuates in their model, it acts only as an indicator for how much borrowing is given to firms for investment in the next period. It is the objective of this study to look at the features of bank decisions on treating their NPLs, and not on how that decision will propagate into other sectors

over the future horizon.

The price of assets is a factor that affects the returns to liquidating bad loans. But typically markets in well traded collateral (for example real estate) are deep and the pricing power of even large banks in such asset markets is low. This gives rise to a phenomenon where even if banks know their collective actions will influence asset markets, each is too small to internalise this into their incentive structure. In that sense, it is sensible that in dealing with forbearance decisions asset prices is not as large a concern as the prospect of making profits from the borrowers, even if the individual decisions will have effects for other banks. In fact, the coordination of lenders' incentives is one of the things that the US Treasury plan for subprime mortgages purports to do, ostensibly by aligning lenders' actions such that they will collectively foreclose less. This way, so the argument goes, it may provide some support to asset prices.

As the various lines of literature on propagation mechanisms document, fluctuations in asset prices can have large effects on aggregate economic activity since it can impact on the amount of loans given for investment and create changes in consumption through wealth effects. As noted above, falling collateral prices can lead to contraction in bank credit, and when it interacts with debt, it can lead to distress selling due to margin calls and trigger contagious downward pressure in collateral markets. These are valid reasons for concern from an aggregate point of view. But some argue that the superior strength of new firms that enter the economy after NPLs are liquidated makes new bank lending a more useful strategy to stimulate economies than protecting old delinquent ones. See for example Fukao and Kwon (2006), Nishimura, Nakajima, and Kiyota (2005) and Caballero, Hoshi, and Kashyap (2006). Depending on how much can be recycled in this process, the new demand created may even overpower the downward influence brought about by selling collateral. This possibility is discussed in this chapter as a consequence of including recycled bank lending as an explicit decision of banks, made possible by relaxing the channel for new production closed off in environments that only

consider liquidation.

Since liquidation of bad loans involves write-offs which can hurt a bank's capital position, it is inevitable a study on bank treatment of NPLs will have to consider issues of bank health. Capital ratio regulation forms an integral part of what is perceived as a bank's strength.[3] It maintains a minimum amount of capital in relation to risky assets and seeks to limit the amount of risky new lending or other investment by banks. In this sense, capital regulation presents a friction that can generate changes in bank behaviour purely by affecting balance sheet variables, and not the liquidity resources of banks.

The effect this regulation has on bank action over NPLs is worth considering because liquidation frequently involves writing them off at a loss, which weakens bank balance sheet positions. Even if it results in better cash flow, it can potentially put banks in breach of such regulation, and force banks to liquidate less than they may desire. This rationale for increased forbearance lending is not based on the profitability of staying with delinquent firms at all. Also, it is frequently cited that capital regulation is procyclical due either to the flight of quality in bank assets (Furfine (2001)) or wholesale downgrading of credit ratings on borrowers (Kashyap and Stein (2004)). This leads to questions over whether capital adequacy regulation as an approach is appropriate for monitoring the loan market, as opposed to market discipline. See Herring (2004).

Aside from the analysis of capital regulation, there are two other areas which relate to the strategic interaction between regulators and banks that warrant interest. They are the issues of regulatory capture and some banks being 'too big to fail'. Regulatory capture points to the phenomenon where some banks, particularly the market leaders, may hold regulators to ransom over the setting and enforcement of bank regulation.[4] An associated problem relates to the moral hazard that comes

[3] For an exhaustive survey of issues surrounding capital regulation and its relation to banks, see Santos (2000).

[4] For more details on how regulators can be influenced by the regulated firms or interest groups, see Laffont and Tirole (1991). Hardy (2006) looks specifically at this problem in the banking

with the regulators' fear of allowing big banks to close down, and how banks may exploit this weakness to their advantage. Both notions are concerned with the fact that some banks or banking groups are bigger or more powerful than others, and in the process of profit maximistion, the bigger ones can somehow influence prudential regulation.[5] Dealing with these issues will require the incentives of the regulator to be considered, as well as to introduce heterogeneous banks in terms of size or scope of business. While acknowledging the importance of these issues, to keep matters simple this chapter shall only focus on the study of the impact of capital regulation on representative banks.

The general setup of the model is described in the next section. In Section 3.3 the response of banks in environments without lending, similar to Chen, Chu, Liu, and Wang (2006), is looked at, and its outcome is then compared to one when there is new lending. Section 3.4 provides discussion on how capital regulation impacts on bank balance sheets. The conditions that such regulation create and banks' response to them are examined in Section 3.5. Section 3.6 concludes.

3.2 Model

The basic setup of the model follows that of Chapter 2, but with other features included. These features are designed to be slight modifications of Chen, Chu, Liu, and Wang (2006), to provide comparison between results. There are three periods: -1, 0, and 1. The analysis concentrates on the current period 0, where agents react to events based on their inherited financial position and expectations. There are three homogenous but distinct groups of people: a continuum of identical banks which finance entrepreneurial production, entrepreneurs (firms) with projects but no productive land and landowners who supply the land. Notice there is no

sector.

[5] For studies on the 'too big to fail' phenomenon, see Kane (2001), Stern and Feldman (2004) and Ennis and Malek (2005).

crossover between groups, meaning landowners lack the skill to become entrepreneurs or bankers and vice versa. The small competitive banks in this world have no influence on the asset market individually. They are therefore price takers and do not introduce strategic complications to the model in a monopolistic setting. But while they cannot influence collateral prices individually, as a whole the collective action of the banking sector does weigh on asset markets.

3.2.1 Banks

To avoid taking on the risk of lending directly to entrepreneurs, the landowners in this economy delegate this responsibility to banks by depositing their funds. But since deposit interest does not add anything to the intuition, or alter any result in the model, here the deposit rate is suppressed to zero.[6] Banks' only activities are to take deposits and make loans. There is no foreseeable potential shock to the economy, so banks do not make any provision or store cash for the event of loan losses. One period before the current time, at the beginning of period -1, each bank has an inherited balance sheet with some deposits with which to make loans. They are each assumed to have optimised their return based on the expected profitability of lending and no adverse shock, and have a loan portfolio that contains loans to P_{-1} entrepreneurs. These P_{-1} 'old' firms each has access to a project that lasts for two periods, but their own resources are not enough to start the projects. To invest, they must take out a fixed loan of value l (with l strictly positive) to purchase land, to be repaid over the life of the projects. Firms must pledge their land as collateral. These projects are identical and produce output at the end of both periods of operation. As will be explained in more detail in later sections, a result of optimisation in this period is that a typical bank lends out all its funds until either all cash is exhausted (section 3.3), or until the capital ratio is at the regulated minimum (section 3.4). To simplify the subsequent analysis and to reflect

[6] Since there is a constant amount of deposits in this model, a non-zero deposit interest rate will simply add a constant cost to the bank, and merely shift the magnitudes of all results by this constant. It does not alter the intuition of any of the results obtained.

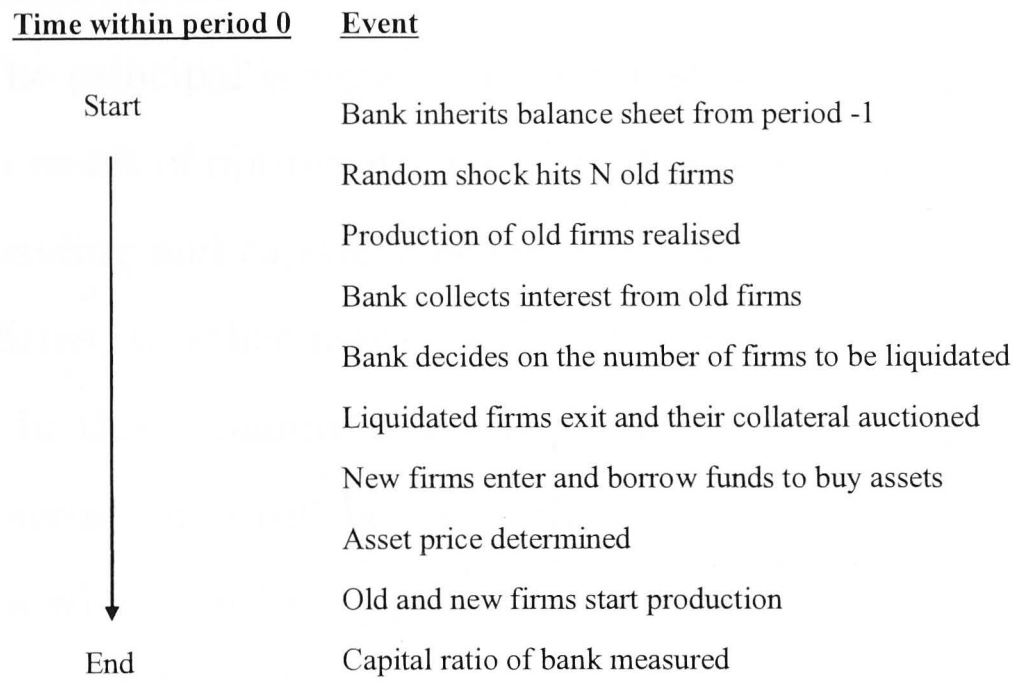

Figure 3.1: Timing of events in period 0

the main results more clearly, this model will assume that in period -1 the optimal action of a bank will be such that all cash is exhausted and the capital ratio touches the regulatory minimum.[7]

3.2.2 Firms

In period 0, 'new' entrepreneurs gain access to a project that lasts for only one period. They each have the same endowment as old firms, $\tilde{k}$, but like the old firms it is too small to start their projects. As a result, to start investing new firms also have to take out loans of size l to purchase land for production. The maturity of their loans is one period, with the purchased land as collateral.

To clarify the timing of events, a figure showing a list of events in period 0 is shown in Figure 3.1.

Output is realised in period 1 for new firms, and in both periods 0 and 1 for

[7] As will be demonstrated in sections (3.3) and (3.5), these two conditions do not have to be present at the same time for a bank to reach its upper limit in lending volume. Cases where only one of these conditions are binding introduce complications into the analysis, which will be considered in period 0. To minimise unnecessary complexity, in period -1, both conditions are assumed to be met concurrently.

old ones. Interest on the loans is paid immediately after outputs are realised each period. The principal is repaid with interest in the last period of a project's operation. As a result of optimisation in period -1, each bank inherits net deposits d available for lending and capital z before any loan is given out in period 0. The projects of all firms, whether new or old, have positive net present value. The discount factor in this economy is given as $R \geq 1$, which ensures the value of holding money across time will be lower than investing in projects. In this case, all entrepreneurs who have the opportunity will start production. From a social point of view, as much land should be employed by entrepreneurs as possible since otherwise the land remains in low productivity.

3.2.3 The asset market and lending environment

The budget constraint facing a new firm entering the asset market is given by

$$q_0 k_0 = q_0 \tilde{k} + l, \tag{3.1}$$

where q_0 is the asset price in period 0, and k_0 is the total amount of asset in investment. Two further assumptions are that each entrepreneur's skill is specific to his own project, and if an entrepreneur runs away, he is not able to siphon any resources already committed to production. Banks will hence only be left with the liquidation value of the collateral. Due to the potential threat that entrepreneurs can walk away from their projects, banks will only lend an amount limited to the liquidation value of the collateral net of liquidation costs. That loss is defined as a fixed proportion c of total receipts.[8] Calculated at the period 1 expected asset price, the size of a loan is:[9]

$$l \leqslant E q_1 k_0 (1 - c)/R. \tag{3.2}$$

[8] This can be due to various reasons, for example legal costs of the bankruptcy process, or transaction costs in executing the sale.

[9] This structure for the analysis of renegotiation and debt repayment is similar to that of Kiyotaki and Moore (1997b) and Hart and Moore (1994). See original articles for more details.

An unexpected shock happens in period 0 and hits $N < P_{-1}$ of the old firms randomly. That makes them unable to pay their first interest payment. Banks have the option to continue financing these projects or to liquidate them. This chapter shall analyse three cases, one in which banks use the funds to finance other projects operated by new firms which only start this period, another in which banks do not, and a third one where banks lend to new firms under a regime of capital regulation. The current capital ratios of banks are measured after all actions are taken. For the $P_{-1} - N$ performing projects, the returns for the next period are independent of the success of the current period, and have a probability $0 < \pi < 1$ of making a profit. For the N non-performing projects, their chance of success declines to θ, $\theta < \pi$. This feature follows what is used in Chapter 2, in allowing for lowering productivity for bad firms. This model shall abstract from the effects of bank provisions to highlight the results more clearly and avoid unnecessary complication.

Faced with this decision, banks can do one of three things:

(1) Rollover the loans, in which case the projects continue. The bank collects nothing in period 0 and attempts to collect both interests plus principal next period.

(2a) Liquidate them and hoard the proceeds, in which case the banks recoup some funds by selling the seized collateral. Define a variable M to be the number of firms among N that is liquidated in period 0, $0 \leqslant M \leqslant N$. Cash holdings of the banks increase as a result. If capital adequacy regulations are in place, then their capital ratios may rise or fall depending on the net gain or loss that result from writing off the bad loans. See section 3.4 for details.

(2b) Liquidate them and use the funds for lending to new firms that start their projects in period 0. The number of new firms that a bank lends to depends on their liquidation decision. See below.

In period 1, final output is realised for all firms. This is the end period for all projects and there is no new entry. Any land used in production is sold to the landowners. Banks attempt to collect from rolled-over old firms the overdue interim interest, the relevant interest for this period, and the principal. For properly functioning old and new firms, banks collect the interest and principal on their loans.

There is a fixed supply of land K and there is no depreciation. All landowners supply their land on demand for new firms entering production. Recall that in this model, different groups of people do not posses the skills necessary to switch into other groups. Therefore, when the asset market closes these landowners simply hold the land not used in production by old or new firms, and are not able to become entrepreneurs themselves to start investing. They are not constrained in terms of resources and have a decreasing returns to scale production technology that allows them to produce with their landholding. The productivity is given by $H'(K - \sum k_0)$, where $K - \sum k_0$ represents total land not used in projects. $H(\bullet)$ satisfies the neoclassical assumptions $H'(x) > 0$ and $H''(x) < 0$ for all x. These assumptions ensure that there is non-zero production whatever the state of the investment environment.[10] The technology can be represented in Figure 3.2. The horizontal axis measures how much land is held by landowners. So point A represents more land used in investment than point B, meaning the land price corresponding to point A measured by $H'(A)$ is higher than at point B.

In period 0, the supply of land comes from both landowners and also banks' liquidated collateral. Due to the unconstrained nature of landowners' production, their benefit of holding land for the current period is equal to the discounted marginal benefit of production $H'(\bullet)$ this period (which is realised in period 1) plus the resale value of the land in the next. So the asset price can be expressed as follows:

[10] This technology raises the production value of landowners if more land is employed in investment by entrepreneurs. This can be rationalised by supposing that landowners produce a good different to investment output. For example, firms produce manufactured goods while landowners produce agricultural products. If more land is used in investment, then the supply of agricultural products decline and their value rises.

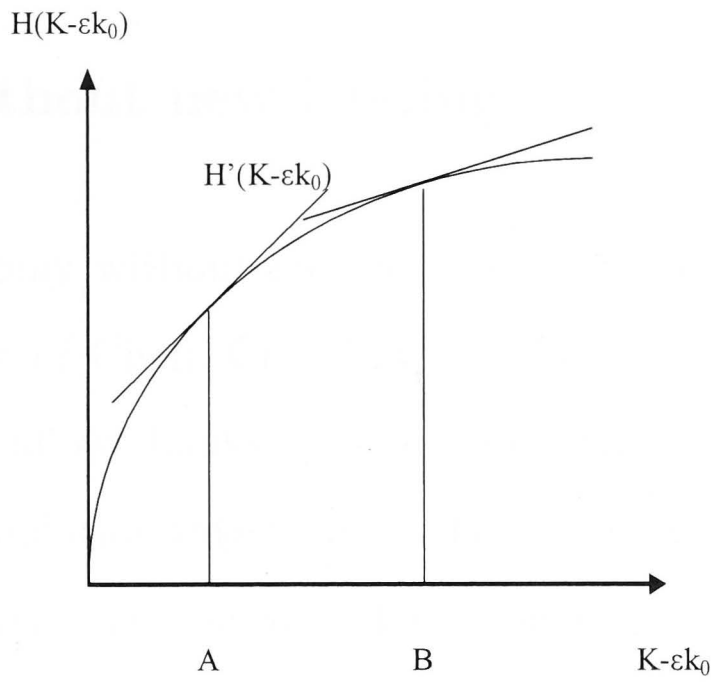

Figure 3.2: Asset price and technology of landowners

$$q_0 = \frac{1}{R}H'(K - \sum k_0) + \frac{Eq_1}{R}, \tag{3.3}$$

where $\sum k_0 = (P_{-1} - M)k_{-1} + P_0 k_0$. From the expression for $\sum k_0$ it is clear that the effect of liquidation per se on the asset market is to depress the asset price. However, this is tempered by the new lending that liquidation makes possible, since it generates new demand for assets from new firms. To facilitate easier understanding of the model, it is useful to impose a functional form for this equation that satisfies the assumptions. Assume the production of the landowners is

$$H = A\ln(K - P_{-1}k_{-1} + Mk_{-1} - P_0 k_0),$$

so the asset price equation becomes

$$q_0 = \frac{1}{R}H'(\bullet) + \frac{Eq_1}{R} = \frac{A}{R(K - P_{-1}k_{-1} + Mk_{-1} - P_0 k_0)} + \frac{Eq_1}{R}. \tag{3.4}$$

3.3 Bank response to the NPLs problem

3.3.1 Banks without new lending

To illustrate the economy without recycled lending, this section depicts an environment based on that of Chen, Chu, Liu, and Wang (2006), by shutting off the recycling channel that allows banks to make new loans. There is no entry of new entrepreneurs after liquidation takes place. The main point of this subsection is to highlight how the economy must produce falls in asset prices if the recycling channel of lending is not considered. In their model, no new entrepreneur will enter the world at period 0. In period 0, the bank chooses a course of action regarding the NPLs based on profit maximisation, by choosing the number of firms to liquidate M. Since no new entrepreneur enters the economy, once the bank auctions off the liquidated collateral, the cash is simply hoarded and lies idle. Except for a cost associated with the process of liquidation, there is no other explicit cost to banks, so banks' expected profit is equal to expected revenue.[11] Hence unlike equation (3.3), here $Eq_1 = 0$ and $P_0 = 0$, meaning $q_0 = \frac{1}{R}H'(K - P_{-1}k_{-1} + Mk_{-1})$. It is immediately apparent that given $H'(x) > 0$ and $H''(x) < 0$, an increase in M will lead to a decline in q_0. Each new case of liquidation causes the asset price, and hence bank receipts from that case, to drop. As there is no new lending to any new firm, there is no such thing as a budget constraint for them, or profit that a bank can expect to make from making new loans. In this scenario, the typical bank's problem is simply to maximise its period 1 expected profit with respect to M:

$$\max_M \frac{1}{R}[(P_{-1} - N)(1 + i_1)\pi l + (N - M)\theta(1 + i_0 + i_1)l] + q_0 Mk_{-1}(1 - c)$$

subject to

[11] The deposit interest is suppressed to zero to simplify the algebra.

$$0 \leqslant M \leqslant N.$$

The above equation says that total expected profit for the bank comes from three sources: performing companies which pay their interest and principal next period; rolled over firms which pay their overdue and current interest and principal next period; and receipts in the current period from liquidation of seized collateral. The constraint simply says that the number of firms liquidated is limited to the number of delinquent firms in the maximum.

Setting up the Lagrangian $\mathcal{L}$, the first order condition is:

$$\frac{1}{R}\theta(1+i_0+i_1)l = q_0 k_{-1}(1-c). \tag{3.5}$$

This condition says that the optimal amount of liquidation should equalise the marginal benefit of rollover on the left hand side and liquidation on the right. Making use of the condition for asset price in this environment one can see the negative relationship between marginal benefit and number of cases of liquidation. Imposing the assumed functional form, the marginal benefit of liquidation without new lending MB_{nl} is equal to:

$$MB_{nl} = \frac{A}{R(K - P_{-1}k_{-1} + Mk_{-1})} \cdot k_{-1}(1-c). \tag{3.6}$$

The case of an interior solution for M is illustrated in Figure 3.3.

From the first order condition (3.5), an expression for q_0 can be found:

$$q_0 = \frac{\theta(1+i_0+i_1)l}{Rk_{-1}(1-c)}. \tag{3.7}$$

This asset price expression can be used with the asset market equation $q_0 = \frac{1}{R}H'(K - P_{-1}k_{-1} + Mk_{-1})$ to find M. Using the assumed functional form, an

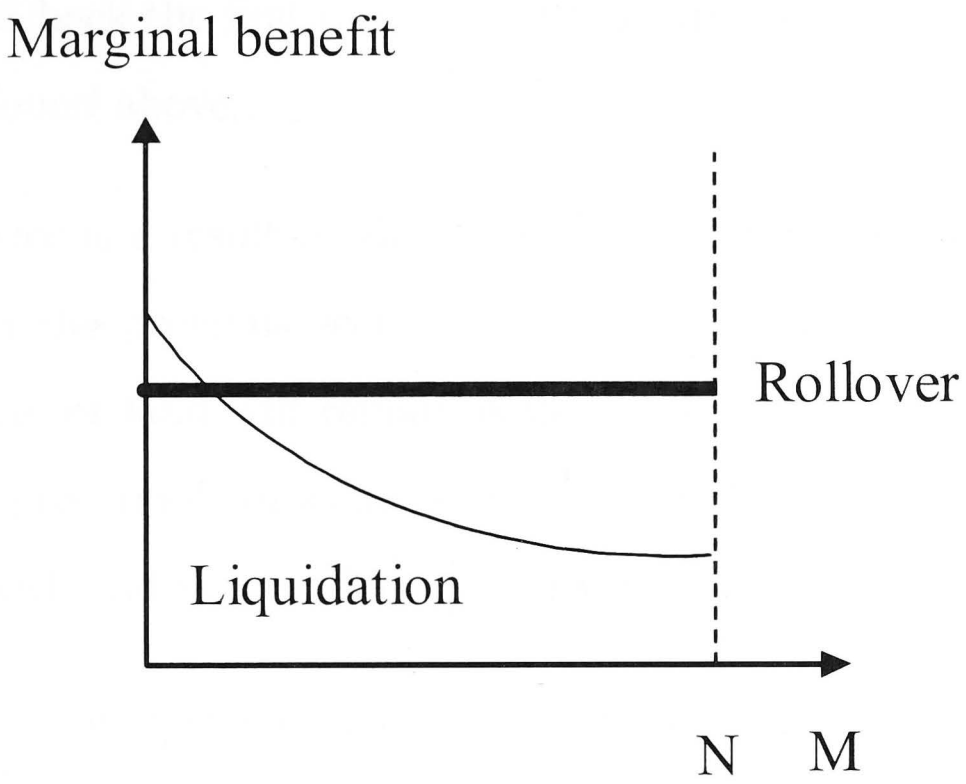

Figure 3.3: Marginal benefit of rollover and liquidation

explicit expression for M can be found by equating it with the equilibrium asset price:

$$q_0 = \frac{\theta(1+i_0+i_1)l}{Rk_{-1}(1-c)} = \frac{A}{R(K-P_{-1}k_{-1}+Mk_{-1})}.$$

Recall that the asset price q_0 will decline as liquidation rises, and that makes recoupment through liquidation less and less fruitful, to a point where it is more valuable to forbear some cases of bad loans.

The explicit solution of M is equal to:

$$M = \frac{A(1-c)}{\theta(1+i_0+i_1)l} - \frac{K}{k_{-1}} + P_{-1}.$$

Note that the rollover payoff, $\theta(1+i_0+i_1)$, is negatively related to liquidation, indicating the decision of banks to liquidate is directly related to the perceived benefit of evergreening.

To find the asset price q_0^*, the solution to M should be put into the asset price equation, in this case $q_0 = \frac{1}{R}H'(K-P_{-1}k_{-1}+Mk_{-1})$. If the values of exogenous parameters is such that M is an interior solution, $0 < M < N$, then this substitution

will simply yield back the first order condition expression (3.5), and q_0^* is equal to equation (3.7) found above.

The asset price is a result of all banks each maximising their respective profit. As explained in the previous section, this price will not decline to zero. The equilibrium price for land will remain equal to the productivity of the land itself if banks do not give any loan at all, since there will then be no investment in this world to start with and no liquidation afterwards.

If the values of the exogenous parameters are such that the condition $0 \leqslant M \leqslant N$ is violated, then the optimal M must be a boundary solution, that is, $M = 0$ or $M = N$. In such cases, the boundary solutions $M = 0$ and $M = N$ must be used, resulting in:

$$q_0^* = \frac{A}{R(K - P_{-1}k_{-1})}$$

when $M = 0$, and

$$q_0^* = \frac{A}{R(K - P_{-1}k_{-1} + Nk_{-1})}$$

when $M = N$.

3.3.2 Banks with new lending in period 0

If banks are allowed the option of investing the recouped cash from liquidation, then due to the positive expected profits they may earn, they will lend out the funds where possible. This has two effects from the banks' point of view: firstly expected profits of the bank do not comprise liquidation receipts directly any more, rather the expected return from new loans given out of those receipts is included; and secondly, the entry of new firms will bring new demand to the asset market, which mitigates the drop in asset prices caused by selling liquidated collateral. The overall impact on the asset market will be the result of a number of opposing effects.

Recall that in the illustration of the environment in Chen, Chu, Liu, and Wang (2006) in the previous subsection, no new entrepreneur enters the economy and

banks do not make any new lending, so liquidation simply recoups some immediate cash. But here, banks have the option to lend to new firms, so the positive expected profits from this action may induce banks to liquidate more than in the case without new lending. Recall also that land has a minimal production value, below the expected value of investment, to new firms as well as banks, which means that the land can be meaningfully pledged in the writing of debt contracts for the new entrepreneurs in period 0. By allowing for the occurrence of recycled lending, the entry of new firms brings new demand for assets, so the asset price maybe supported somewhat (or even overwhelmed) by this new demand. Hence the decline in asset prices in event of bank foreclosure may not be as severe as commonly referred to if bank activity in granting new loans is considered.

To keep the model simple, there is no crossover between landowners, entrepreneurs and banks as mentioned in Section (3.2). That means even if there are cases where, for example, the return to investment is more attractive than that of agricultural production, landowners and bankers cannot switch and become entrepreneurs and disrupt the supply of land. The assumption is made that there is a steady inexhaustible supply of new entrepreneurs into the economy.

To illustrate the maximisation, certain details regarding the lending behaviour of banks must first be made clear. It is helpful to start with viewing the balance sheet of a typical bank before and after events take place in period 0.

Table 3.1: Balance sheet at start of period zero

Cash	$d + z - P_{-1}l$	Deposit	d
Receivables	$P_{-1}l$	Capital	z

At the start of period 0 each bank has net deposits d available for lending, and capital in cash to the size of z. That means each bank has $d + z$ in cash with

which to lend out. The bank has lent l dollars each to P_{-1} firms, so the amount of accounts receivable is $P_{-1}l$. As a result of optimisation in period -1, each bank lends out all its cash in parcels of l dollars each to old firms. Assuming there is no interbank borrowing, in period -1 a binding cash constraint prescribes that:

$$d + z = P_{-1}l.$$

In the course of period 0, the following three things happen that will impact on the balance sheet of a bank:

1) The $P_{-1} - N$ performing projects pay interim interest $(P_{-1} - N)i_0 l$ in total (each firm pays interest at rate i_0 on its loan of value l). This is cash income for the bank. Notice that this is independent of the amount of liquidation a bank undertakes. It enters the balance sheet with the following entry denoting increases in the relevant accounts:[12]

DR	Cash		$(P_{-1} - N)i_0 l$	
	CR	Capital		$(P_{-1} - N)i_0 l$

2) M projects out of those N non-performing ones are liquidated. The bank recoups $q_0 k_{-1}(1 - c)$ per project from selling collateral, where q_0 is the collateral price in period 0. At the same time, those M loans are written off. Assuming the bank makes a loss upon liquidation, the net write-off is the difference between the

[12] Strictly speaking, the credit side should be entered into the Interest Income account, but for the purposes of this model, this income is considered as profit, and since there is no dividend or other costs, the whole sum becomes retained profit which counts as capital. To simplify matters, this entry cuts the many intervening accounting entries and only shows the final effects on the accounts.

two, $Ml - q_0 Mk_{-1}(1-c)$. On the balance sheet, the final effects are represented by this simplified entry:[13]

DR	Capital		$Ml - q_0 Mk_{-1}(1-c)$	
DR	Cash		$q_0 Mk_{-1}(1-c)$	
	CR	Receivables		Ml

3) The bank, after having collected cash from events (1) and (2), then proceeds to lend out the funds to new entrepreneurs. This amount is equal to $P_0 l$ subject to a limit on available cash. These funds include two components:

a) liquidation receipts of $q_0 Mk_{-1}(1-c)$.

b) interest income $(P_{-1} - N)i_0 l$ from point (1).

The $N - M$ NPLs are supposed to attract an extra capital charge in calculating the capital ratio. For purposes of illustration such charges are not included in this model. In any case their inclusion does not affect any of the qualitative results. For a discussion on bank provisioning, see section 3.4.1. Non-provisioning for bad loans has been the practice of many banks in many countries in which regulatory regimes are not properly enforced. As documented in Peek and Rosengren (2005), this was also the case for Japanese banks in the 1990s.[14] In this model, since the non-recognition of problem loans means no provision or expense is made to the accounts, there is no change to the capital ratio. The number of new firms receiving

[13] Again, the debit to Capital should go through an expense account representing the net write-off, and the debit to the Cash account should be made to an asset account to record the possession of collateral. Here it is assumed that the collateral is sold at market price, and the resulting net write-off carries through as a retained loss to the Capital account. If the sale results in a book profit, then it should increase capital, thus necessitating a credit entry to the Capital account instead.

[14] The 'evergreening' practice in Japan frequently involves giving an extra loan equal to the size of the current interest payment, which the borrower uses to pay the bank. In this way, the loans are not classified as non-performing. This is partly condoned by the authorities because proper recognition of bad loans would greatly reduce the capital ratios of banks and possibly cause panic in the general public.

a loan is found in the maximisation. The balance sheet at the end of period 0 is constructed in Table 3.2.

Table 3.2: Balance sheet at end of period zero

Cash	Deposits
$d + z - P_{-1}l + (P_{-1} - N)i_0 l$	d
$+q_0 Mk_{-1}(1-c) - P_0 l$	Capital
Receivables	$z + (P_{-1} - N)i_0 l - Ml$
$P_{-1}l - Ml + P_0 l$	$+q_0 Mk_{-1}(1-c)$

To find out the maximum amount of new loans that is feasible for period 0, the cash constraint must be consulted. It should be obvious from the size of $P_{-1}l$ and point (3) above that the maximum amount of available funds is equal to liquidation receipt plus interest income. Given the positive expected return of new projects, banks will lend out all their funds, so this constraint will be binding:

$$d + z - P_{-1}l + (P_{-1} - N)i_0 l + q_0 Mk_{-1}(1-c) = P_0 l, \tag{3.8}$$

Armed with the list of events, the balance sheet, and the cash constraint it is now possible to detail the maximisation problem of a bank. Recalling $d+z = P_{-1}l$, the Lagrangian takes the following form:

$$\max_{M,P_0} \frac{1}{R}[(P_{-1} - N)(1+i_1)\pi l + (N-M)\theta(1+i_0+i_1)l + P_0 l\pi(1+i_1)]$$

subject to

$$d + z - P_{-1}l + (P_{-1} - N)i_0 l + q_0 M k_{-1}(1 - c) = P_0 l,$$

$$M \leqslant N,$$

$$q_0 \geqslant \frac{A}{R(K - P_{-1}k_{-1} + Mk_{-1} - P_0 k_0)}.$$

The last constraint describes the asset price to be at least equal to or larger than the minimum production value of the land if it is not used in investment. However, with the recycling channel in operation, and the fact that interest income in event (1) being independent of liquidation, there must always be some lending to new firms that purchase land. This constraint will therefore never bind in this environment.

By setting the last two constraints to be non-binding ($\lambda_2 = \lambda_3 = 0$), the relevant first order conditions of the Lagrangian are:

$$-\frac{1}{R}\theta(1 + i_0 + i_1)l + \lambda_1 q_0 k_{-1}(1 - c) = 0, \tag{3.9}$$

$$\frac{1}{R}l\pi(1 + i_1) - \lambda_1 l = 0. \tag{3.10}$$

In this environment, a bank is considering the marginal returns to rolling over the firms which produce an expected return of $\frac{1}{R}\theta(1+i_0+i_1)l$, against the expected return of liquidating and then lending out the funds. The first order condition (3.9) says that liquidation should proceed until the marginal benefit of rollover, the negative term, is equal to the marginal benefit of liquidation. This marginal benefit comes directly from the recouped funds when selling collateral. The second equation (3.10) gives a relationship between the marginal benefit of giving each new loan against its cost. From this equation λ_1 can be worked out as $\lambda_1 =$

$\frac{1}{R}\pi(1+i_1)$, meaning the shadow benefit of liquidation is simply the discounted expected return from new lending. A non-zero λ_1 confirms the cash constraint to be binding. Substituting this into equation (3.9), an expression for the asset price q_0 can be worked out:

$$q_0 = \frac{\theta(1+i_0+i_1)l}{\pi(1+i_1)k_{-1}(1-c)}. \tag{3.11}$$

Given the shadow price of new loans for banks, this level of q_0 will result at the optimum, equalising marginal benefit and marginal cost of liquidation for banks. For details of how this is arrived at, see Appendix A.

A relationship between M and P_0 can be worked out if q_0 is put into the cash constraint equation (3.8), with $d+z = P_{-1}l$. The resulting expression for M and P_0 is:

$$M = \frac{[P_0 - (P_{-1} - N)i_0]\pi(1+i_1)}{\theta(1+i_0+i_1)}. \tag{3.12}$$

This expression states that with all exogenous parameters held constant, the more liquidation there is, the more new firms will get loans. This is sensible since one of only two endogenous sources of funds for new lending comes from liquidating bad loans (the other is interest income from good firms). Contrast this with the previous section where there is no new lending. Here more liquidation actually contributes to more new loans, which can potentially increase expected profit for banks. The first bracketed term in the numerator represents the funding gap between new loans and interest income, and it must be made up by liquidation receipts. Also reflected in this expression is the idea that if the returns to rollover $\theta(1+i_0+i_1)$ is higher, the less liquidation there should be, and vice versa for the liquidation return $\pi(1+i_1)$.

Details of solving for other variables is found in Appendix A.

The trade-off between marginal benefit and cost for the bank is illustrated in Figure 3.4, similar to Figure 3.3. From the Lagrangian, one can find the total (and hence marginal) cost to liquidation is the same as the case without lending in section 3.3.1. The total benefit to liquidation is

$$P_0 l\pi(1+i_1).$$

Making use of the binding cash constraint (3.8) results in $P_0 l = (P_{-1} - N)i_0 l + q_0 M k_{-1}(1-c)$. So the marginal benefit with respect to M is equal to $q_0 k_{-1}(1-c)\pi(1+i_1)$. Drawing on the fact that the price floor constraint for q_0 is not binding, it means that $Eq_1 > 0$. So the form of the asset price equation here is identical to equation (3.4). That yields the marginal benefit MB_{cash} to be:

$$MB_{cash} = \left[\frac{A}{R(K - P_{-1}k_{-1} + Mk_{-1} - P_0 k_0)} + \frac{Eq_1}{R}\right] \cdot k_{-1}(1-c)\pi(1+i_1). \quad (3.13)$$

Comparing this marginal benefit expression with the one without lending in equation (3.6), it is easy to see $MB_{cash} > MB_{nl}$. Due to the recycling channel, the demand for land by new firms pushes up the asset price by giving it an expected non zero value in period 1, demonstrated by $\frac{Eq_1}{R} > 0$. Also, the extra land used in investment by new firms means $P_0 k_0 > 0$, making the productivity of the landowners rise (see footnote 10). As well, the expected return of lending to new firms, $\pi(1+i_1)$, is larger than 1 as assumed to ensure banks will lend to new firms. These changes shift the MB_{cash} line upwards in Figure 3.4, resulting in more liquidation.

Recall that in this model, each bank is too small to be able to affect the asset price, but collectively, their actions form a sectoral influence on the land market and hence on its equilibrium price. To compare the outcome of this environment meaningfully with the one without lending in section 3.3.1, it is useful to note that there is a chance the asset price actually rises when new lending is given out, whereas that is not possible without the recycling channel operating to generate new loans. The proposition below summarises the result.

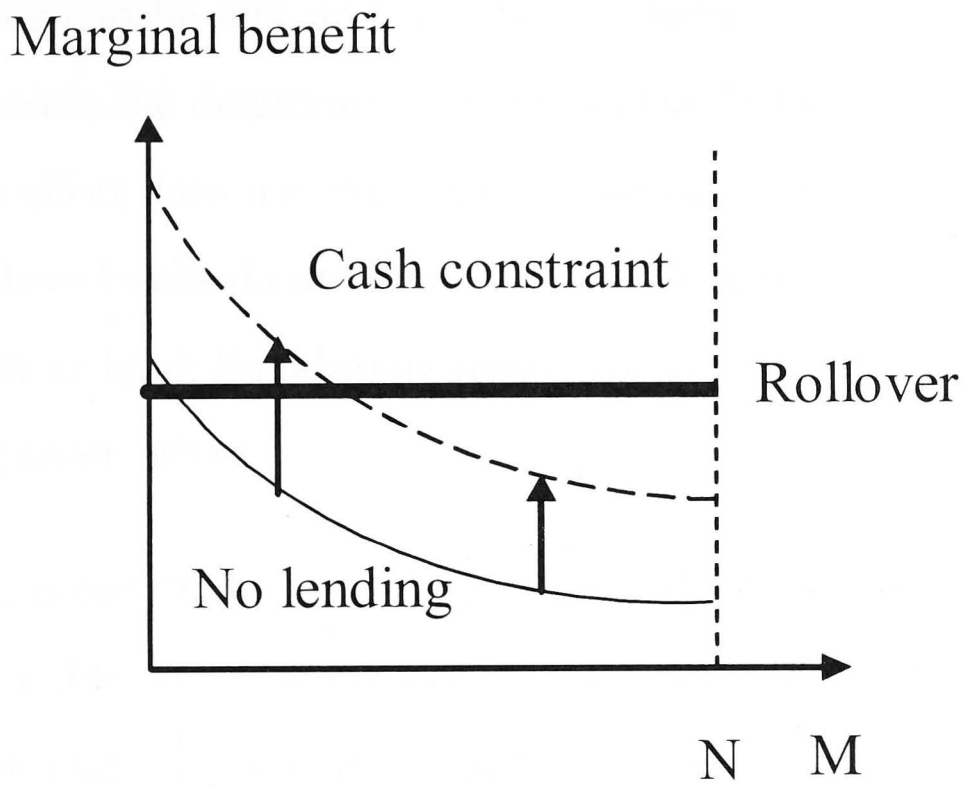

Figure 3.4: Marginal benefit of liquidation with cash constraint

Proposition 1 *The asset price will rise if the proportional cost of liquidation c is smaller than the down payment as a fraction of total investment* $\frac{\tilde{k}}{k_0}$. *Otherwise, the asset price will drop.*

Proof. See appendix B. ■

The critical point occurring at $\frac{\tilde{k}}{k_0}$ is a result of the inflow of new firms with their endowment. To understand this result it is useful to think of the size of funds active in the asset market due to the liquidation process. In the course of liquidating loans, banks recoup a body of funds from which a proportion c is lost. This amount is then lent away to new firms in constant-sized loans, who seek to start their investment by using their endowment $\tilde{k}$ to make downpayments in their loans. That means if new endowment as a proportion of total land purchased, $\frac{\tilde{k}}{k_0}$, is higher than the proportion lost in liquidation, it will have more than replaced this loss and result in more funds in the market demanding land than before. The asset price therefore rises as a result. Intuitively speaking, the more costly liquidation is, the less funds will be recouped and lent out to new firms. The smaller this demand is, the less support there is to the asset price. Alternatively, if the cost is small,

then more money can be lent and it becomes possible that the support from new demand overwhelms the downward pressure of the liquidation and makes the asset price rise. This effect does not exist in environments with no new firm entering the economy and where banks do not lend out their liquidation receipts. It means that models that look at bank liquidation alone can only conclude in linking foreclosure with depressing asset prices.

It should be noted that collateral in this model is assumed, on liquidation, to be readily convertible to a new project without cost. If this assumption is relaxed, it means the demand for assets may not be as strong as the case illustrated in this section, since new entrepreneurs will have to cover an extra cost to convert their assets to suit their projects. When that is the case, the demand for loans may not be as strong as before, hence weakening the recycling channel. In the real world, the collateral pledged to banks can take many forms, such as land, physical chattels, productive machinery, and even a borrower's financial assets or streams of income. Among these types, some are easily and cheaply converted into cash by the bank and used for new lending; others, like land, are fairly flexible in converting usage with a cost. However, certain types of assets and productive machinery may only be suitable for limited uses and have shallow resale markets, thus making it difficult for banks to quickly convert into cash for recycling. Typically, a bank with firms in various industries as customers will have a mix of different categories of assets as collateral.[15]

In the case of this model, with land being the collateral analysed, there are likely some obstacles to the recycling of collateral though they are by no means

[15] The fact that banks can take hold of a specific asset upon default (in contracts known as 'fixed charges' in legal parlance) implies a limitation on firms that they may not sell them in the course of business. That in turn limits the kinds of assets that firms can usefully pledge as collateral. As such, it is also fairly common that banks hold collateral that is not a designated item, but rather a stipulated amount of a class of assets ('floating charges'). Such charges allow collateral pledged to be traded freely by entrepreneurs and so raises both the kinds of assets and the amount that can be pledged. The benefit of floating charges for banks are twofold: the amount loaned can be raised and more easily convertible collateral is pledged. The result is a mix of types of collateral, some of which can be converted more quickly than others. For more information, see Finch (2002).

prohibitive and land continues to be commonly accepted by banks for mortgages. Entrepreneurs will incur extra cost if there are government regulations on land use. Environmental and zoning assessments are made which takes time and sometimes result in a fee or mitigating action (such as reforestation or infrastructure works) that must be paid or completed before the new project is approved. A concrete example of such regulation occurs in Hong Kong, where the government frequently charges entrepreneurs a 'land premium' when the type of activity on the land changes.[16] Also, geographical limitation may mean that in each region there is a smaller number of new entrepreneurs entering the economy, so demand for land may be reduced. To locate firms in regions far away from their markets means entrepreneurs face higher transportation costs, which should also reduce the attractiveness of this option. For studies on how geographical factors can affect investment and the demand for productive land, see Fujita, Krugman, and Venables (2000) and references therein.

Be that as it may, as with other studies that consider collateral prices and bank lending, in this model these costs are suppressed so that complications with the different cost structures are avoided.

3.4 Capital Adequacy Ratio (CAR)

The capital ratio is calculated for each typical bank as a requirement by authorities. In its most simple form, the capital ratio is equal to total eligible capital divided by total risk-weighted assets. The commonly accepted Basel standard for this ratio is a minimum of 8%. The idea of imposing capital regulation is to use a financial constraint to limit the risk-taking behaviour of banks, and in so doing improve their

[16] Information given on the website of the Lands Department of Hong Kong states that "[m]odifications [of land use] ... shall ... be granted at premium reflecting the difference between the 'before' and 'after' land value" (Lands Department of Hong Kong (2005)). The 'land value' is assessed on the basis of the kind of activity on it, e.g. industrial, residential or commercial and the specific industry of the new venture. For more details, see the Lands Department website http://www.landsd.gov.hk.

risk profile as measured by on-balance sheet items.[17]

This model will use the standardised approach in Basel II to calculate this ratio. See Basel Committee on Banking Supervision (2006) for details. In this model the regulatory minimum is the lower bound that banks' capital ratio must reach, defined as $\underline{CR}$. Operation at a ratio under this level is ruled out. In measuring risk-weighted assets, a 100% risk weight will be used for all risky assets. This will not alter any of the conclusions obtained and simplifies matters a great deal.

3.4.1 The impact of bank provisioning

Provisioning is an important way for banks to buffer against loan losses and can have a sizable influence on bank capital ratios. It involves expensing some current period profits to set up a buffer against which future bad loans can be written off. Essentially this reduces current year accounting profits in return for a smaller drop in future profits in case bad loans occur. In calculating the capital ratio it is stated in Basel Committee on Banking Supervision (2006) that, subject to certain limits, general provisions not set aside for a particular known adverse event can be included under Tier 2 capital, and risky assets can enter the ratio net of any specific provisions set against them. So while current profits and Tier 1 capital drop as a result of provisioning, it does not negate the benefit it brings to the overall capital ratio.

While there are BIS (and in some countries, specific accounting) guidelines over what level of provision is appropriate for what sort of potential losses, the final decision is down to the management of the bank, and banks do frequently provision more than prescribed by guidelines. But these decisions are mainly dictated by market conditions and by business strategy, and are hence outside the scope of this

[17] In the last few years, the events in the banking sector concerning write-downs on subprime related securities have drawn attention to banks' tendency to not recognise risky assets on the balance sheet. How such off-balance sheet items can be regulated properly by capital adequacy rules remains to be seen.

study. Indeed, sometimes the amount of provisioning is recognised as a proxy for the management's assessment of future prospects, and this may affect the amount made in the first place.

As a result, while acknowledging that provisioning adequately is one way of protecting a bank's capital ratio from suffering large drops in event of borrower default, this model will not consider the effects of bank provisions. This is so because the decision over how much provision to make is not modelled, and only including the bare minimum required by guidelines will complicate the algebra but add very little intuition. For example, the occurrence of an NPL will result in a capital charge equal to a percentage of the amount. This adds a constant to the denominator of the capital ratio, worsening the capital position of a bank and hence reduces its scope to make new lending. Suffice to say the inclusion of such provisioning will act to tighten the capital ratio as a constraint on a bank's lending behaviour.

3.4.2 The CAR constraint

By not including bank provisions, it means that bank equity forms all eligible capital, and a bank's decision on the amount of liquidation and its associated write-offs should be the only things affecting a bank's balance sheet.[18] To look at the capital position of a typical bank, recall the two balance sheets in Tables (3.1) and (3.2) from section 3.3.2. There is $d + z$ in cash (of which z is capital) loaned out in period -1 at l per firm to P_{-1} firms. As mentioned in section 3.2, to simplify matters for comparison, in period -1, banks have optimised and as a result lent out the maximum amount of funds allowed by regulations. That means $CR_{-1} = \underline{CR}$:

$$CR_{-1} = \frac{z}{P_{-1}l} = \underline{CR}.$$

[18] Recall that banks in this model do not make any interbank loans or hold or issue securities that can affect their capital ratios.

In period 0, both the numerator and the denominator of the CAR change if there are write-offs of NPLs or collections of cash. Events that happen in period 0 and discussed in section 3.3.2 have the following effects on the CAR. For ease of reference, they are listed below:

1) Interest income amounting to $(P_{-1}-N)i_0l$ enters the balance sheet as retained profits under capital. It raises the capital ratio.

2) Liquidation of each project gives a bank $q_0k_{-1}(1-c)$, but at the same time a loan of l is written off. Aggregated over M projects, the net change in the numerator can be either up or down, while risky assets (denominator) are cut. The impact on the capital ratio CR_0 depends on whether the recoupment from sale is sufficiently large to cover a proportion $(1-CR_{-1})$ of the write-off. If it does, then the capital ratio rises and vice versa.

3) New lending is made subject to the capital ratio constraint. This amount is equal to P_0l, which may be all or part of the sum of liquidation receipts $q_0Mk_{-1}(1-c)$ and interest income $(P_{-1}-N)i_0l$. The size of this amount depends on the amount of liquidation M and the CAR regulatory minimum.

As mentioned in section 3.3.2, non-performing projects which are rolled over remain off-balance sheet, because there is no occurrence of any transaction, as opposed to the regular treatment required by accounting standards which writes off a certain amount against bad debt provisions.

The period 0 capital ratio can be computed from the balance sheet for period 0 in Table (3.2). This must obviously also be equal to or above the regulatory minimum:

$$CR_0 = \frac{z+(P_{-1}-N)i_0l+q_0Mk_{-1}(1-c)-Ml}{P_{-1}l-Ml+P_0l} \geqslant \underline{CR}.$$

Since the CAR requirement is positive, and given the attractiveness of engaging in as much lending as possible (because the expected return on projects is positive,

hence firms should on average have no problem making interest payments), the banks should lend out all its funds until $CR_0 = \underline{CR}$, if they are not otherwise limited by the cash constaint. Rearranging the above results in the CAR constraint:

$$z + (P_{-1} - N)i_0 l + q_0 M k_{-1}(1 - c) - Ml \geqslant \underline{CR}(P_{-1}l - Ml + P_0 l). \tag{3.14}$$

The above constraint shows that while the CAR somewhat protects the health of banks, it does so by only limiting the recycling of bank loans, denoted by $P_0 l$. That means the recycling channel, which can provide crucial support to the asset market, may be compromised.

3.5 Bank action under capital regulation

3.5.1 Liquidation under the CAR constraint

If CAR regulations are imposed, then bank lending is now subject to both the cash and CAR constraints (3.8) and (3.14). To see what the feasible set of bank actions will be when they are bound by these two constraints, it is helpful to detail the maximisation problem under only the CAR constraint, and then compare with alternative cases, for example the one without the CAR in section 3.3.2. While the cash constraint is important because it is the absolute limit of new bank lending, here the question of interest is whether CAR regulation will become a tighter constraint on bank lending in some circumstances.

Recalling that in period -1 banks' optimisation results in both $\underline{CR} = z/P_{-1}l$ and $d + z = P_{-1}l$, the maximisation problem with CAR regulation is

$$\max_{M,P_0} \frac{1}{R}\left[(P_{-1} - N)(1 + i_1)\pi l + (N - M)\theta(1 + i_0 + i_1)l + P_0 l\pi(1 + i_1)\right]$$

subject to the CAR constraint (3.14):

$$z + (P_{-1} - N)i_0 l + q_0 M k_{-1}(1 - c) - Ml \geqslant \underline{CR}(P_{-1}l - Ml + P_0 l),$$

cash constraint (3.8):

$$d + z - P_{-1}l + (P_{-1} - N)i_0 l + q_0 M k_{-1}(1 - c) = P_0 l,$$

the price floor constraint:

$$q_0 \geqslant \frac{A}{R(K - P_{-1}k_{-1} + Mk_{-1} - P_0 k_0)},$$

and

$$M \leqslant N.$$

The case with only the CAR constraint binding requires taking $\lambda_1 > 0$ as its multiplier and $\lambda_2 = \lambda_3 = \lambda_4 = 0$ for the other non-binding constraints, the first order conditions are:

$$-\frac{1}{R}\theta(1 + i_0 + i_1)l + \lambda_1(\underline{CR} - 1)l + \lambda_1 q_0 k_{-1}(1 - c) = 0, \tag{3.15}$$

$$\frac{1}{R}l\pi(1 + i_1) - \lambda_1 \underline{CR}l = 0. \tag{3.16}$$

There is an extra term $\lambda_1(\underline{CR} - 1)l$ in the first order condition (3.15) compared to equation (3.9) in the cash constraint case. That term represents two opposing effects specific to the CAR constraint with its balance sheet-based nature. When liquidating a loan, it must be written off on the balance sheet (see accounting entry (2) in section 3.3.2), and this marginal cost is represented by $-\lambda_1 l$. But after writing off this bad loan, capital set aside for it is not required any more. This is a marginal benefit to liquidation, to the amount of $\lambda_1 CRl$. These two effects

have no particular bearing on the cash position of a bank, as witnessed by their non-appearance in the cash constraint (3.8), but here they affect bank behaviour nonetheless. The sign of this term is negative, which means under a binding CAR constraint, liquidation is more costly than in the cash constraint case, giving rise to the possibility that the CAR can potentially be stricter on banks regarding liquidating bad loans.

Substituting λ_1 from the second condition (3.16) into the first (3.15) yields the asset price in equilibrium:[19]

$$q_0 = \frac{[\underline{CR}\theta(1+i_0+i_1)+(1-\underline{CR})\pi(1+i_1)]l}{\pi(1+i_1)k_{-1}(1-c)}. \tag{3.17}$$

Putting this expression back into the CAR constraint (3.14), the relationship between M and P_0 can be found:

$$M = \frac{\pi(1+i_1)[z+(P_{-1}-N)i_0 l-\underline{CR}l(P_{-1}+P_0)]}{-\underline{CR}\theta(1+i_0+i_1)l}. \tag{3.18}$$

This is the CAR analogue of expression (3.12). Despite the negative sign in the denominator, Appendix D shows this expression for M to be positive. As with the cash constraint-only case in section 3.3.2, explicit expressions for the endogenous variables can be found by repeated substitution using equations (3.1), (3.2) and (3.3) from the firms sector, asset market, and an imposed functional form for $H'(\bullet)$, as detailed in Appendix A.[20] The relationship here between M and P_0 is a positive one, indicating, just like the cash constraint case, that more liquidation makes more funds available for new lending. As expected, the amount of liquidation (and hence the amount of new lending) is conditioned by the regulatory minimum, as the original point of capital regulation is to limit the amount of risky assets in a bank's portfolio.

[19] Again, see Appendix A for details of solving for the variables.

[20] Boundary solutions can be obtained if the solution for M is below 0 or above N. If $M = 0$ then the CAR constraint is not binding, it regresses into the cash constraint case, so $P_0 = (P_{-1}-N)i_0$. If the bank optimised $M = N$, then using the CAR constraint the optimal $P_0 = \frac{1}{\underline{CR}}\left[\frac{\pi(1+i_1)}{\theta(1+i_0+i_1)}N\underline{CR}+(P_{-1}-N)i_0\right]$. The resulting asset price will therefore also be different.

3.5.2 Binding conditions for the CAR constraint

To find out at what range of values which constraint will bind tighter, the expressions for M in the cash-constrained and CAR-constrained cases (3.12) and (3.18) are used to construct a graph with the two control variables on the axes. Again recalling that from period -1 that $\underline{CR} = z/P_{-1}l$ and $d + z = P_{-1}l$, the two equations are rearranged into the following for user-friendliness:

$$P_0 \leqslant \frac{1}{l}[(P_{-1} - N)i_0 l + q_0 M k_{-1}(1 - c)], \tag{3.19}$$

$$P_0 \leqslant \frac{1}{\underline{CR}l}\{(P_{-1} - N)i_0 l + M[q_0 k_{-1}(1 - c) - (1 - \underline{CR})l]\}. \tag{3.20}$$

Consider equation (3.20), the term in square brackets $\frac{1}{\underline{CR}l}[q_0 k_{-1}(1-c)-(1-\underline{CR})l]$ represents the marginal change of P_0 if M is increased by one unit (it is the slope of this line). It says that this change is proxied by the difference between the liquidation receipt $[q_0 k_{-1}(1 - c)]$ minus the write-off l, augmented by the capital freed up by this write-off, equal to $\underline{CR}l$. Recall the last item is simply the result of a reduction in capital requirement due to the write-off which decreases the amount of risky assets on the balance sheet. Given that in this model it is assumed that the expected return of lending to entrepreneurs is positive, and it is impossible for bankers to switch into other forms of production, the sole task for banks is to decide how much to liquidate so that new loans can be given out to capture the future expected profit. As such, it is not sensible to have this term negative. A negative slope would imply rising liquidation M but reduced new lending P_0, meaning funds are hoarded at the expense of positive expected profit from new loans. In this environment, no profit-maximising bank will liquidate if it results in less new lending. Hence this equation must have a positive slope.

The case where the cash and CAR constraints cross each other is presented in Figure 3.5. To look for the feasible set of bank action under each constraint,

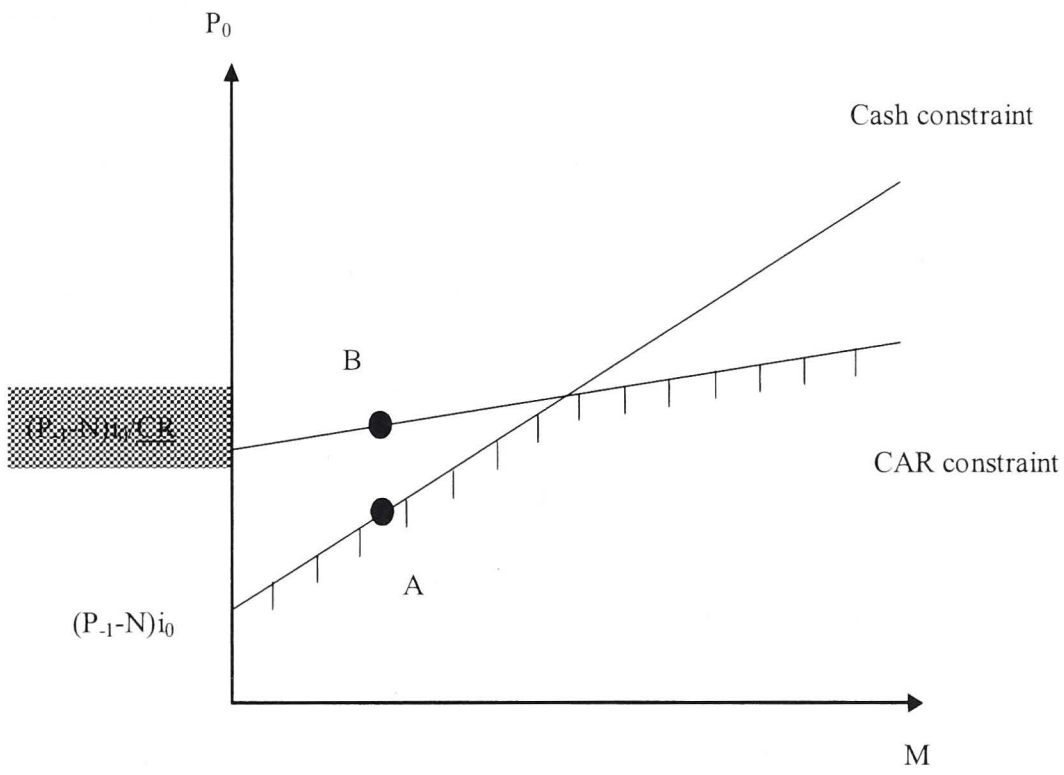

Figure 3.5: The cash and CAR constraints cross

consider point A if the bank is only under a binding cash constraint. This binding constraint prescribes that total cash available is less than total loans allowed by CAR. If M rises, then cash on the right hand side of cash constraint (3.19) becomes larger than P_0, which is feasible under the cash constraint. So the feasible set in Figure 3.5 is below the cash constraint. The same exercise can be done to the CAR constraint (3.20) with point B. A rise in M makes the right hand side rise, confirming that the number of loans cannot be larger than the allowed maximum by capital regulation. So the feasible set in Figure 3.5 for a CAR constrained bank is also downwards. Putting both together, it means that if a bank is under constraint from both, then the feasible set of actions is in the area below both lines, denoted by the vertical shading.

Proposition 2 *The CAR constraint will only bind at any stage of bank liquidation if receipt from each case of sale is smaller than its write-off on the balance sheet.*

Proof. From Figure 3.5, the CAR becomes a concern to banks if liquidation rises to beyond the intersection point of the two lines (to the right of the graph). The two constraints will cross if the slope of CAR constraint (3.20) is smaller than that

of the cash constraint (3.19). That is:

$$\frac{1}{\underline{CR}l}[q_0 k_{-1}(1-c) - (1-\underline{CR})l] < \frac{1}{l}[q_0 k_{-1}(1-c)].$$

Rearranging, this condition becomes:

$$q_0 k_{-1}(1-c) < l. \tag{3.21}$$

■

The condition given in this proof says that when the receipt from a case of liquidation $q_0 k_{-1}(1-c)$ is lower than its corresponding write-off l on a bank's balance sheet, then the CAR constraint will bind at some stage. This is because there is a net loss in capital for the bank, and generates a drop in its capital ratio.

The asset price q_0 under a binding CAR constraint is given in equation (3.17). Substituting into condition (3.21) given in Proposition 2, one finds that the condition only holds when the expected payoff to liquidation is larger than that of rollover: $\pi(1+i_1) > \theta(1+i_0+i_1)$. Intuitively, this condition can be understood as a higher expected payoff to liquidation leading to more new lending, which increases the riskiness of banks and so brings the possibility that the CAR constraint binds.

There is also a case where the CAR constraint is not binding at all, which occurs when the slope of the cash constraint is smaller than or equal to that of the CAR constraint. That condition boils down to $q_0 k_{-1}(1-c) \geqslant l$, which says receipts from each case of liquidation is equal to or larger than the write-off on the balance sheet. This corresponds to a case where $\theta(1+i_0+i_1) > \pi(1+i_1)$. It means liquidation results in a profit on the balance sheet, and will actually raise the capital ratio. This situation is represented in Figure 3.6.

The marginal benefit of liquidation under the CAR constraint can again be

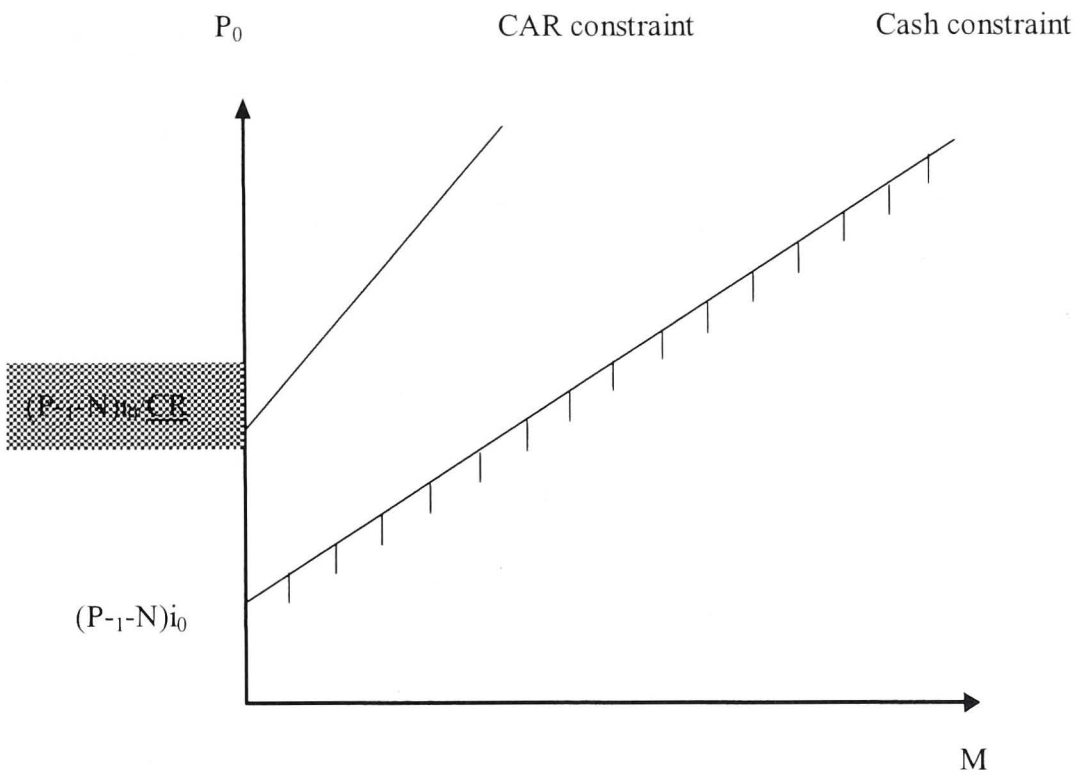

Figure 3.6: The CAR constraint never binds

looked at from the expected revenue function. The total expected return to liquidation is again

$$P_0 l\pi(1+i_1),$$

and substituting for $P_0 l$ using the binding CAR constraint (3.20), the total benefit can be expressed as

$$\frac{\pi(1+i_1)}{\underline{CR}}[z+(P_{-1}-N)i_0 l - Ml + q_0 Mk_{-1}(1-c) - \underline{CR}lP_{-1} + \underline{CR}Ml].$$

Substituting for q_0 with the asset price equation (3.4) and highlighting it with square brackets, the marginal benefit MB_{CAR} with respect to M is therefore:

$$\begin{aligned} & MB_{CAR} \qquad (3.22) \\ = \; & \frac{\pi(1+i_1)}{\underline{CR}} \left\{ \left[\frac{A}{R(K - P_{-1}k_{-1} + Mk_{-1} - P_0 k_0)} + \frac{Eq_1}{R} \right] k_{-1}(1-c) - (1-\underline{CR})l \right\}. \end{aligned}$$

To compare what happens with the CAR constraint case against the cash constraint case in section 3.3.2, it is useful to notice that compared to MB_{cash} in equation (3.13), MB_{CAR} has an additional $-(1-\underline{CR})l$ term, but its effect is coun-

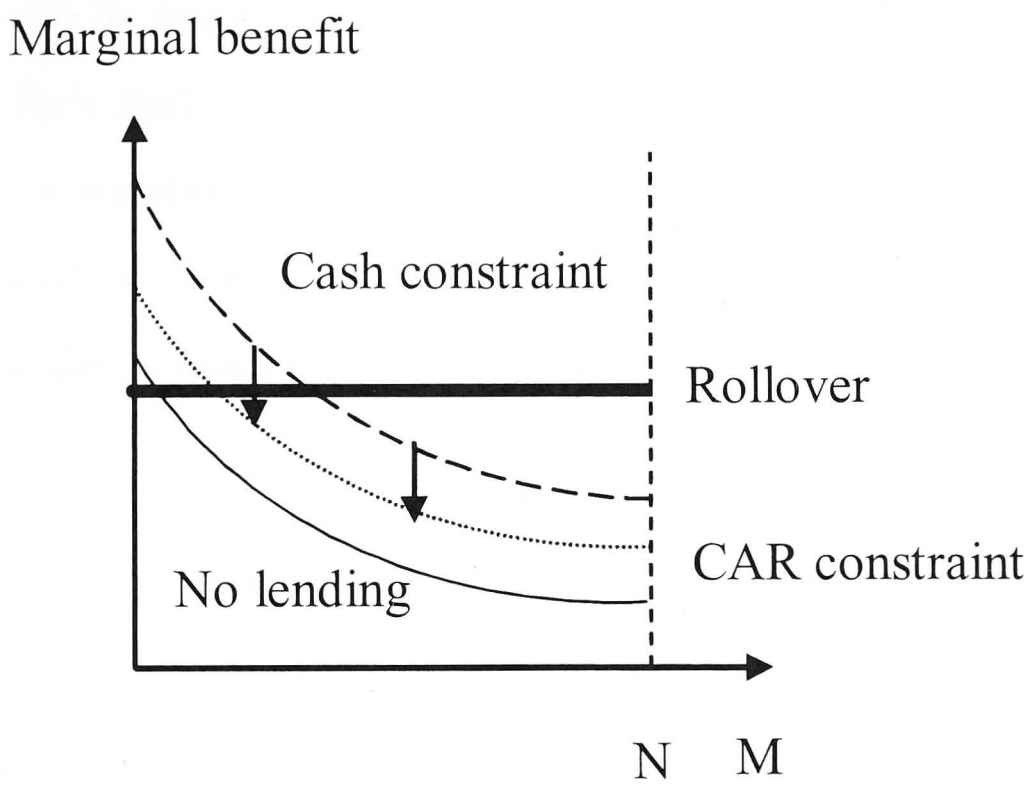

Figure 3.7: Marginal benefit under CAR constraint

teracted by the division by $\underline{CR}$. To know which one is larger, one must consult the other conditions already established in this section. Recall that in constructing Figure 3.5, it is determined that the slope of the CAR constraint (3.20) must not be negative. This means $q_0 k_{-1}(1-c) - (1-\underline{CR})l \geqslant 0$, so MB_{CAR} is positive. Also, since $q_0 k_{-1}(1-c) \geqslant l$, the CAR constraint will never bind, meaning only the cash constraint binds. Proposition 2 proves that a binding CAR constraint must have $q_0 k_{-1}(1-c) < l$.

Notice that with the above information, MB_{cash} in equation (3.13) can be expressed as $q_0 k_{-1}(1-c)\pi(1+i_1)$. Since $q_0 k_{-1}(1-c) \geqslant l$ for a binding cash constraint, $MB_{cash} \geqslant l\pi(1+i_1)$. The MB_{CAR} expression (3.22) can be written as $\frac{1}{\underline{CR}}[q_0 k_{-1}(1-c) - (1-\underline{CR})l]\pi(1+i_1)$, but crucially, $q_0 k_{-1}(1-c) < l$. Consider $q_0 k_{-1}(1-c) = l - \varepsilon$, $\varepsilon > 0$. Substituting $l - \varepsilon$ into MB_{CAR} gives $(l - \frac{\varepsilon}{\underline{CR}})\pi(1+i_1)$. Hence it is clear that the marginal benefit in the cash constraint-only case is higher than the CAR case, because $l\pi(1+i_1) > (l - \frac{\varepsilon}{\underline{CR}})\pi(1+i_1)$. On a diagram, the marginal benefit line will hence be lower than in the cash constraint case, as shown in Figure 3.7.

The exact magnitude of liquidation that makes both the cash and CAR con-

straint binding can be found by maximising the bank's problem under the relevant conditions, and then finding an explicit solution to M. Call this intersection M_{int}. Under a regime of capital regulation, if the condition in Proposition 2 holds, and the level of liquidation chosen by banks is higher than M_{int}, then the capital ratio will present a binding constraint to the amount of new lending banks can engage in.

This gives rise to a situation of forbearance lending due to problems with declining bank health. It is so because when a bank's liquidation is constrained by the CAR, its level of liquidation is above M_{int} and it is not able to liquidate as much as desired by profit maximisation without CAR regulation. The CAR constraint only binds when the capital ratio is at the minimum $\underline{CR}$. Since the capital ratio is a measure of bank health, it follows that the bank's health must have deteriorated to a point where liquidation cannot proceed any further.

In other words, when liquidation rises to a certain extent, banks are forced to stop and forbear some bad loans due to declining bank health. Compared to the case without the CAR constraint in section 3.3.2, this is clearly forbearance of a different sort. Without the CAR constraint, banks choose how much to liquidate according to the trade-off between expected return on rollover and liquidation, and recycle the funds into new loans without any limitation. Any concious choice of forbearance is made with the purpose of profit maximisation, where all monies recouped from liquidation can be lent out. With the CAR constraint, it is conceivable that some bad loans are kept operative purely because it will cause too much harm to the bank's health if liquidated. In other words, CAR regulation introduces a non-monetary cost to banks by formalising bank health as an explicit consideration, on top of profits alone. As writing off bad loans damages bank health (even if it gives longer term benefits in cleaning up bank balance sheets, allowing more new loans to be made), it becomes more costly to write off such bad loans. This finding is in agreement with Peek and Rosengren (2005) who find that some Japanese banks were forbearing loans in the 1990s because writing them off would hurt them too

much. It also leads to the insight that the imposition of CAR regulation dampens the introduction of new demand into the land market. Its effect on asset prices is summarised in the next proposition.

Proposition 3 *If minimum capital requirements are binding on banks, then the asset price rises when such capital requirements are lowered and vice versa. If it is not binding, then there is no effect.*

Proof. See Appendix C. ■

By limiting the amount of liquidation and new lending, the impact of the CAR regulation on the land market will be reducing both the supply and demand of collateral, and preserving the existence of some old, delinquent firms. In this light, the CAR imposes a constraint on bank profit maximisation. It is hence an impediment to the 'recycling channel' of bank loans, curtailing its crucial support to the land market. As suggested by Pringle (1974), Furlong and Keeley (1989), Gennotte and Pyle (1991) and *Diamond and Rajan (2000)* among others, changes in capital regulation can result in banks changing their risk profiles. Along this line of reasoning, it is conceivable that varying the CAR countercyclically is a possible policy lever in managing the economy, and that is borne out in this model by the above proposition. See Goodhart (1995). For example, within the setup in this model all banks should operate at the minimum ratio $\underline{CR}$ for profit maximisation, so that in economic downturns, relaxing capital regulations increases the amount of liquidation and boosts the recycling channel in the economy, thus providing support to the land market.

It must be highlighted that the result of Proposition 3, while mathematically confirming the use of a fluctuating CAR as a tool for economic management, does not provide automatic support for it. This is due to a number of other factors that make countercyclical manipulation difficult. As Rajan (2009) points out, in market downturns investors demand safety, so lowering the CAR may not lead banks

to respond with more lending. Equivalently, when markets recover after a bust, banks and investors alike will like less capital and more loans, putting up strong resistance to the idea of raising the CAR to its erstwhile level. The enforcement of such regulation may also lead banks to shift activity off balance sheet, to such bodies as structured investment vehicles (SIV), which are unregulated. The effectiveness of this kind of action is therefore different in economies with banks of varying risk profiles and appetites. See also Gorton and Winton (1995).

3.6 Conclusion

This chapter has shown that in considering the effects of bank actions in treating their NPLs, it is crucial that both the supply and demand side of asset markets must be considered. Contrary to suggestions that more liquidation must result in depressing asset prices, inclusion of the recycling channel of bank lending can bring in new demand which supports and may even raise asset prices overall. It is also shown that forbearance of NPLs can result from two sources, from normal profit maximisation as well as from declining bank health. It means that both polar opinions of asking banks to provide stimulus by either liquidating all bad loans swiftly, or to forbear them are not helpful. Not only may this bring banks further away from their natural profit maximising behaviour, it can also harm bank health by reducing their capital ratios. If the deviation from profit-maximisation and deterioration in health leads to problems in the banking sector, then the extra stimulus to the macroeconomy from more lending may be negated.

The capital ratio is demonstrated to be binding on banks only at higher levels of liquidation. Larger negative shocks that generate more NPLs also allow the possibility for banks to liquidate more bad loans. They are hence more likely to be prevented from liquidating their NPLs by capital adequacy requirements. This limitation is an impediment to the recycling of bank funds into new loans, reducing the support this gives to asset prices, and may allow lower resultant asset prices to

harm the economy. The constraint on cleaning delinquent loans is also associated with higher levels of forbearance. It does so by introducing a cost to the liquidation process in terms of bank health, and not through private profit maximisation or direct governmental intervention based on macroeconomic concerns. Movements in capital standards are demonstrated to have a negative relationship with respect to asset prices, which affirms the mechanics for using the capital ratio as a tool for economic management, notwithstanding the trade-off in weaker health for banks, and other problems with making this an active economic policy.

Many simplifying assumptions are made in this model to emphasise the main messages. But there are a number of extensions which can yield interesting insight into explaining bank attitudes in dealing with bad loans. For example, liquidity risk is entirely omitted in this model, so banks in this model can lend until either cash is exhausted or if the minimum capital ratio is reached. For most banks in the world, this is not the case. By including the incidence of random shocks on the liquidity position of banks (and not just on the profitability of its customers), it further strengthens the importance of the cash position of banks, and is likely to induce banks to hoard liquidity, possibly reducing the strength of the recycling channel.

There is also a question over whether banks will become more conservative after the arrival of negative shocks. To banks in this model, the firms' probabilities of success are defined as exogenous, and decline after a shock hits a firm. But it may be the case that firm productivities are related to past performance in different ways, as may be appropriate for companies in different industries. This has the potential to alter the forecasts of banks over expected profitability, and change their decision in choosing how many bad loans to liquidate. Events in credit markets in 2008 suggest this maybe the case with firms in certain industries suffering more from a shortage of bank loans. It may also be because of the impossibility of forming precise estimates for the prospects of bank customers. If uncertainty is introduced into the forecasts of banks, then it is likely to cloud their profit maximisation activity. Given the

special value of safety to the banking sector, perhaps the market for bank loans will suffer from this increase in information asymmetry. The effect this has on the liquidation decisions of banks, though, is uncertain, since it is unclear whether it is safer to liquidate delinquent firms and hold cash as buffer, or allow some of them to continue operating at the expense of other firms about which banks have typically less information.

The above point is also related to the issue of reputational effects. This can affect decisions with NPLs in two different ways: the public's perception of banks given firms' past histories; and the reputation of banks in response to changes in capital regulation. It is quite possible that if a bank's financial statements show large amounts of delinquent loans (or even just higher amounts of loan loss provisions), then it is construed by the public as a signal for financial hardship ahead, and leads to pressure on its management, even if they are not in any financial trouble. In this case, banks may decide on its liquidation action based on factors other than pure profit maximisation.

Also important, particularly to regulators, is the public image of banks if CAR requirements are relaxed in economic downturns. While it allows banks to make more lending legally, they may also be seen as becoming less safe, which can mean banks are reluctant to take up the extra latitude afforded to them. This poses questions about the usefulness of lowering capital ratios as a policy, as opposed to injection of capital into the banking sector. A notable case study is in the change of capital regulation in Japan in the 1990s to include deferred tax assets, which result from current losses, as Tier II capital. This action simply serves to raise the capital ratios of banks, without changing their financial performace or cash flow positions at all. To take these factors into account, relationships between perceptions of bank safety and expected return must be specified, and parameters such as perceived safety included in the objectives of banks. This issue is of particular importance as it can shed light on the effectiveness of policies aimed at helping banks in economic downturns.

Chapter 4

Assessing the Strength of the Bank Lending Channel in Australia

4.1 Introduction

The bank lending channel of monetary policy transmission refers to a process by which the effects of monetary policy are transmitted to the economy through variation in the quantity of loanable funds. Depending on the financial position of individual banks, the amount of funds made available for bank lending can change as their cost of funding is affected by changes in the central bank's policy interest rate or regulatory changes.[1] The most commonly cited example of a model of the bank lending channel is Bernanke and Blinder (1988). A functioning bank lending channel refutes the Modigliani and Miller (1958) theorem of perfect capital markets, because it relies on both banks and bank customers not being able to switch between sources of finance without costly effort. This can only be the case when the exchange of information is based on imperfect disclosure in the balance sheets of both banks and borrowers.

[1] Other main sources of funds for banks are to draw on deposits and issuing securities on the financial markets. Kashyap and Stein (2000) and Kishan and Opiela (2000) have shown that small banks and those with less financial strength react more to changes in monetary policy. This gives support to the idea of imperfect capital markets, since otherwise all banks should be able to substitute into other sources of funds effortlessly and mitigate the effects of monetary policy.

The literature on the transmission mechanism has identified a number of possible ways through which monetary policy is transmitted. Among them, the traditional interest rate channel of monetary transmission suggests the main effect of monetary policy is through affecting the demand side of the economy. In contrast, the credit channel is concerned with policy effects transmitting through influencing the aggregate amount of credit in circulation. Within it, the balance sheet channel considers the demand for bank loans being constrained by fluctuations in borrowers' balance sheet positions, while the bank lending channel affects the supply of bank loans, influenced in turn by bank balance sheets. See Bernanke and Gertler (1989) and Bernanke and Gertler (1995).[2]

The condition of banking sectors around the world in the past few years provides a good case in point to demonstrate the effect bank balance sheets can have on the real economy. While the aversion of banks to making new loans in the last few years maybe out of concern for borrowers' ability to repay (an observation sympathetic to the balance sheet channel of monetary tramsmission), it may also be because banks themselves are constrained by declining financial strength or regulatory tightening, which can lead to a shrinking supply of loans. If that is the case, loosening monetary policy by simply cutting interest rates alone may not be effective as transmission through the banking sector is incomplete. This incomplete transmission happens because in the traditional interest rate channel monetary policy is discussed mainly in the context of stimulating aggregate demand, but if the extra high-powered money made available is simply hoarded by banks, then it may render such stimulus ineffective.

As described in de Fontenay, Corbett, Grenville, and Henckel (2008), the financial crisis that started in 2007 is characterised by problems with market liquidity – the inability of banks to trade their assets at reasonable prices.[3] This leads to

[2] There are also some other channels through which monetary policy is transmitted, for example exchange rates, and wealth effects. They are not the main focus of this chapter.

[3] Mark-to-market accounting rules enacted in the last few years also play a part in producing reversals in balance sheet positions, in that firms must value their assets according to latest prices much more frequently than before. When markets trend downwards, banks must recognise losses

declining 'funding liquidity', a contraction in the volume of bank lending based on shortage of interbank market funds and weak bank health. As a response, there have been efforts to strengthen the health of banks by capital injection in an attempt to relax banks' financial constraints, which may lead to a larger supply of bank loans. Also, the policy of supplying funds to the banking sector through accepting a larger variety of bank assets as collateral can be understood as a way to reduce the cost of funding for banks.[4] The reason such steps are taken to shore up the banking sector stems from a belief that bank loans represent an important source of funding to the general public. This belief ties in well with one of the conditions of the bank lending channel.

The global financial crisis has also brought to light the importance of the interbank market to the economy. Over the last decade, securitisation activity has greatly changed the way financial intermediaries fund themselves. As suggested in Adrian and Shin (2008), its increase has led to a new breed of broker-dealer institutions with business strategies that do not depend directly on the level of bank deposits. The important point, they suggest, is that these institutions maintain high levels of leverage for business purposes by drawing funds from the interbank markets. Since commercial banks, with their large deposit bases, are active participants in the interbank markets, this phenomenon gives new importance to the bank lending channel. While broker-dealer intermediaries may have taken market share from the commercial banks in supplying credit, they deal heavily with commercial banks, which themselves also participate in the securitisation process. Bank lending, in other words, is not only a potentially unique source of funding to businesses, but also to other financial intermediaries.

As the bank lending channel is based on the imperfect exchange of information

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regardless of whether they have actually sold any of their assets. For a discussion of the challenges such rules raise to central banks, see Goodhart (2006).

[4]In Japan in the 1990s, there have been policies to simply tolerate lower capital standards, through lax accounting measures and allowing 'evergreening' of non-performing loans by banks. These are more controversial because they do not help the overall financial health of banks. But broadly speaking, they can also be understood as methods to free banks from immediate pressure to contract their loan books.

between demand and supply of finance, there is a view that empirical work on the bank lending channel is most meaningful if done on commercial loans data, since at least some firms are big enough to be able to access capital markets without incurring prohibitive costs, providing a useful contrast to researchers. For example, in Kashyap and Stein (2000), the bank loan data used is from the 'commercial and industrial loans' category. Huang (2003) finds that small non-listed firms in the UK bear the brunt of reduced bank loans related to contractions in monetary policy, and in severe tightenings, even the smaller listed companies which are usually more bank dependent than larger ones are affected. The typical mortgagee in the housing market, in comparison with firms, is without ready and cheap access to other sources of finance, and information asymmetry between providers and users of mortgages is much stronger. It is thus highly likely that the bank lending channel has a strong influence in the mortgage market, regardless of developments in the commercial loans market, as found in Iacoviello and Minetti (2008). If the impact of the bank lending channel is reduced for bigger firms compared to smaller ones, and the firms sector in general compared to households, then it raises the possibility that individual firms may react differently to monetary policy. The degree to which monetary policy in Australia affects different firms through influencing the volume of bank loans is an interesting question that deserves investigation.

The institutional features of the Australian banking environment provides reason for one to believe the bank lending channel plays an important role in the economy. In a European cross-country analysis, Ehrmann, Gambacorta, Martinez-Pages, Sevestre, and Worms (2001) list a number of factors, which give a broad indication of whether it is likely the bank lending channel has a powerful effect. To summarise, the stronger a country is in each of the four areas below, the less sensitive bank credit is to monetary policy changes. Australia's relatively low score in each of the areas points to a strong influence being exerted by the bank lending channel:

a) state influence in determining credit flows – after deregulation in the 1980s,

there is little interference from the government in the destination or volume of credit flows in Australia;

b) relationship lending – this is not thought to be strong in Australia, and in countries with similar market structures (the so-called Anglo-Saxon type of financial system);[5]

c) size of deposit insurance[6] – previously there has been no deposit insurance scheme in Australia, but the Australian government implemented a guarantee on corporate and retail deposits and bank wholesale funding from November 2008 for a period of three years. While its scope had undergone changes since that date, a limited guarantee capped at A$250,000 had remained in force since February 2012.[7]

d) extent of bank networks – it is generally believed that banking networks are not strong in Australia, even though the banking sector is concentrated in four big banking groups.[8] But it should be noted that since deregulation in the 1980s, all Australian banks face open competition from overseas banks that are frequently many times larger, and that all banks can draw freely on international funding at world interest rates.

An important point of note in the Australian case is that over a longer term horizon, there are reasons to suspect the mechanism of the bank lending channel may have changed, because of steps to deregulate the financial sector. Since the 1980s, securities markets have developed rapidly, and Australian banks are able to

[5] Allen and Gale (2000) has an exhaustive survey of the features of different types of national financial systems and how relationship lending may be more prevalent in some of them.

[6] Moral hazard deriving from deposit insurance can possibly lead to more risk taking by banks, including 'gambling for resurrection' behaviour. This means banks may ignore monetary policy and engage in more lending.

[7] For details of the scheme and changes made since, see official press releases at http://www.guaranteescheme.gov.au/links/.

[8] In 2008, there were signs that the Australian banking sector had become more consolidated. Mergers include Commonwealth Bank's buyout of BankWest, previously owned by the Halifax Bank of Scotland, Westpac Bank's acquisition of RAMS home loans, and its subsequent merger with St. George Bank. While some of them still operate with separate trademarks, it nevertheless raises the possibility of colloboration within the group.

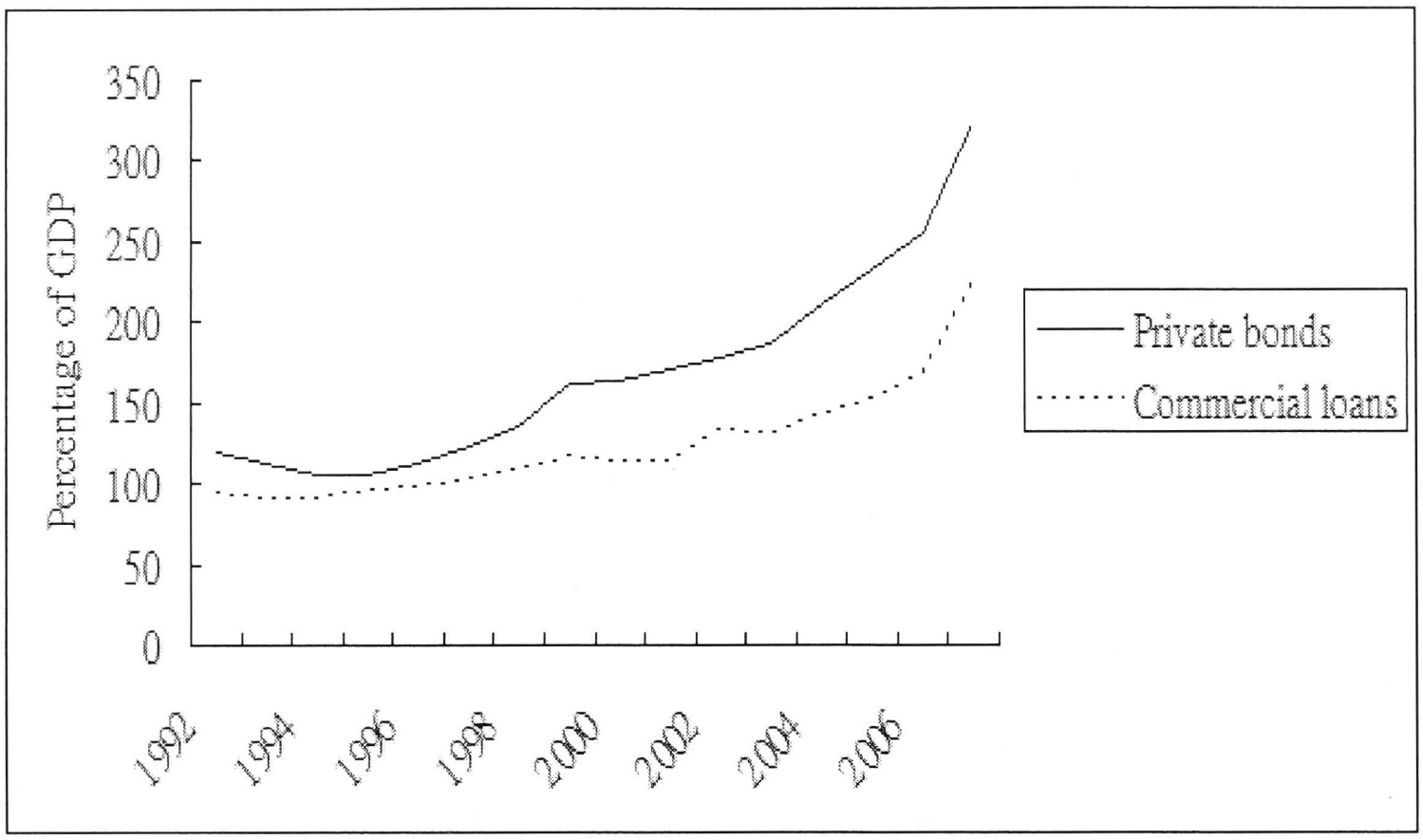
invest and compete overseas. These changes have combined to make the traditional supply of funds for bank loans, the deposit base, less important. For example, the Australian dollar was floated in December 1983 and capital account regulations relaxed. In 1985, foreign banks were allowed to operate in Australia. Together these policies contributed to much foreign currency lending. In June 1985, foreign currency liability formed 4.35% of total bank liabilities and trended almost consistently upwards to over 40% in 2006. This figure remained above 35% even when the global financial crisis started in 2007.[9] These policies enable banks to borrow overseas at different interest rates, so the notion that the supply of bank loans is influenced by a deposit base directly dependent on local monetary policy may need to be revised. Also, firms can more easily borrow from overseas debt markets. A result of the rapid development of the securities markets is that more loans can be generated by the financial sector. At the same time, more debt finance can be raised on the bond markets, in which banks themselves are also major participants. Given that Australia has persistent current account deficits, it is conceivable that the shortage of savings is mitigated by borrowing from foreign sources. More details on the Australian banking sector reforms can be found in Appendix F.

For Australia, the development of securitisation activity has benefitted both the private debt markets and the banking sector, the growth of which have far outpaced that of GDP. In Figure (4.1), total commercial bank loans and private debt securities are expressed as a percentage of GDP.[10] The lower trajectory for commercial loans may suggest a reduction in its importance to firms, but as shown in Figure (4.2), taken from Davis (2007), the ratio of stock market capitalisation to banking sector assets remains less than 100% in the past 30 years, while the stock of corporate bonds is very small throughout. The banking sector is clearly very important to the Australian economy. This phenomenon in Australia is similar to

[9] Author's calculation. Data from Reserve Bank of Australia Bulletin Statistics Table B3 and D3.

[10] Author's calculation. Source: Nominal GDP data from International Financial Statistics series '19399.B.CZF. . .'; private bonds and commercial loans from Reserve Bank of Australia Tables D5 and D4 respectively.

Figure 4.1: Commercial loans and private bonds to GDP in Australia



other industrialised countries, where bank loans typically form a sizable part, if not the majority, of business finance. See Mishkin (2007).

From the preceding discussion, two hypotheses related to the bank lending channel in Australia can be set out:

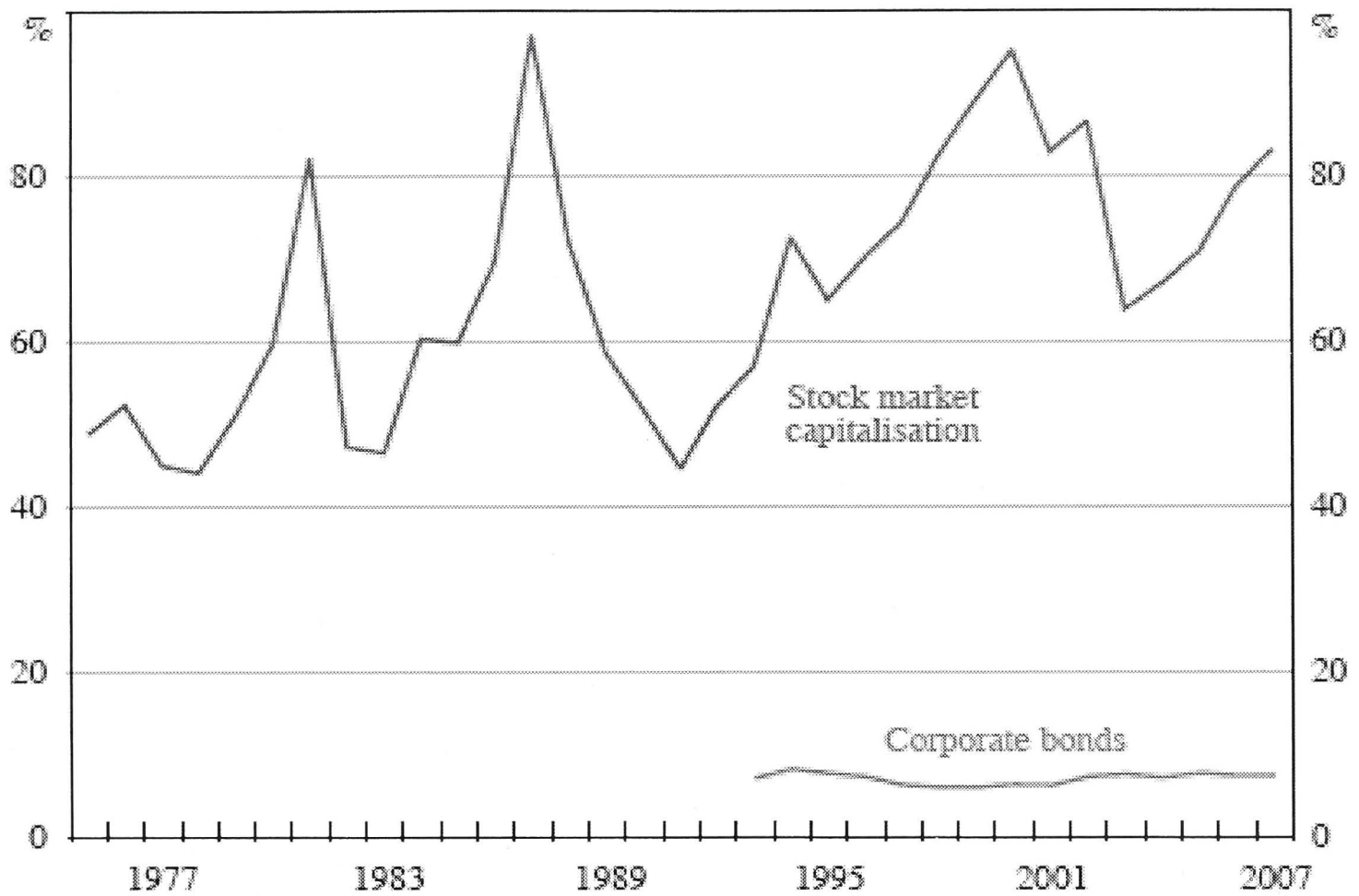
H1: foreign currency borrowing increases the supply of funds in Australia, thus reducing the financing limitations of firms that rely heavily on bank credit. In other words, the influence of the bank lending channel is weakened.

H2: larger firms, which generally have more avenues of raising funds, tend to be less affected by the bank lending channel.

Because of its importance to monetary policy, in recent years a multitude of studies were done on different countries to try to measure the bank lending channel. To date, the only study on the bank lending channel for Australia is Suzuki (2004).[11] It investigates whether this channel 'dominates' when compared to a traditional interest rate channel. A separate finding shows foreign currency liabilities to be

[11] An article published by the Reserve Bank of Australia (Grenville (1995)) on the monetary transmission mechanism in Australia only briefly mentions credit rationing as a possible factor in affecting credit aggregates, without elaboration.

Figure 4.2: Ratios to bank assets (Davis 2007)



an important source of supply of funds for Australian banks. However, while it establishes the relative importance of the bank lending channel, the finding that it does not dominate gives no indication of what can affect its strength. As Angeloni, Kashyap, Mojon, and Terlizzese (2002) conclude in a study of the eurozone, while in some countries the traditional interest rate channel does tend to dominate, a functioning bank lending channel cannot be dismissed for many in the sample, including large economies as Germany and Italy.

The main contribution of this chapter is to add Australian evidence to the literature on studying the bank lending channel. This study complements the results offered by Suzuki (2004) by looking into the factors that can affect the potency of the bank lending channel in Australia using commercial loans data. At issue is how firms, regarded as more able to obtain market finance than the typical mortgagee, are affected by monetary policy through changes in the volume of bank loans offered. The short run adjustment of the spread between bank loan rates and bond rates is examined to shed light on the strength of the bank lending channel.

If firms are able to switch between sources of finance easily, meaning the influence of the bank lending channel is weak, the difference in rates in the bank loan and bond markets should be very small throughout. Figure (4.3) plots the spread for three different loan series used in the estimations in this chapter.[12] In the graph, SA represents the difference between bank lending rates and government bond yields, while SB and SC refer to the difference between business loan rates below and above $2m respectively. It is clear from inspection that the spread is not constant, reflecting the fact that at different times the bank lending channel fluctuates in strength.[13] Analysis of these fluctuations can be of interest to banking authorities in Australia as it gives clues on possibly a different way in which firms react to monetary policy changes, and hint at the likelihood of success of policies designed to work through the bank lending channel.

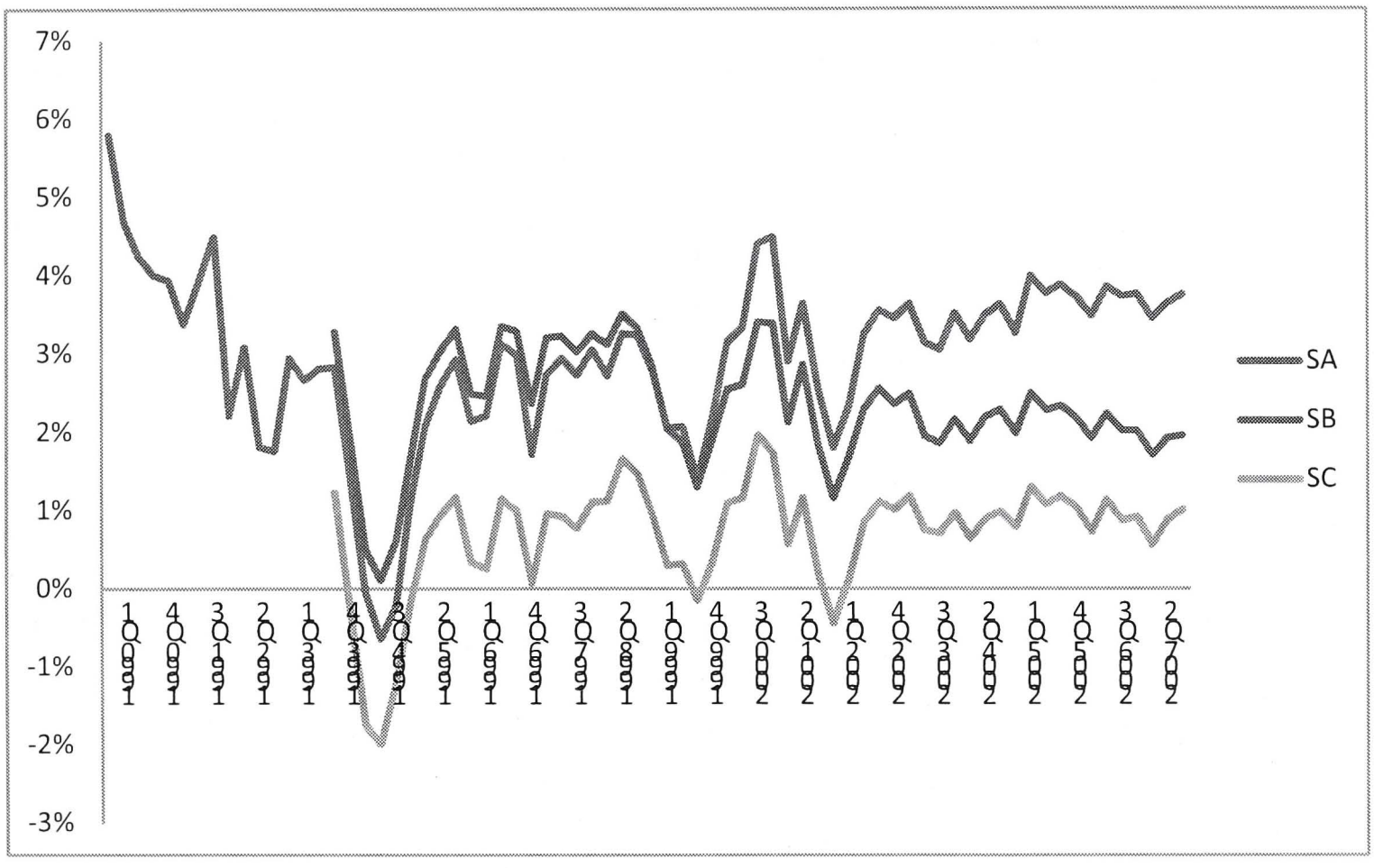
Due to problems in identfying what component of actual data on bank credit is due to supply or demand for bank loans, most studies exploit the information contained in bank level data to uncover information on the bank lending channel, by looking at loan volumes from banks of different sizes and strengths. However, the number of banks in Australia is small, and most lending activity, in particular commercial lending, is dominated by the four big banks. Since one objective of the study is to investigate the reaction of commercial lending, this raises the question of not having enough observations to build a wide enough panel for analysis. In this chapter, the use of available aggregate time series data in Australia closely resembles that of the bloc of big banks due to the highly concentrated nature of the banking sector.[14] The estimation strategy used here does not rely on identifying

[12] Author's calculation. Source: bank lending rates for SA are obtained from IFS data series '19360P..ZF . . .'. Loans rates for loans below and above A$2m for SB and SC are both taken from the Reserve Bank of Australia Table D8. Notice that due to potential differences in the method of calculating lending rates, the SA series constructed from IFS data show higher rates than RBA numbers used for SB and SC for long periods of time. For a discussion of issues related to the loan rates data see section (4.4).

[13] As will be discussed in section (4.4), five-year government bond yields are used as a surrogate for commercial bond yields and applied to the construction of SA, SB and SC. Commercial bond yields data do not stretch back far enough for purposes of analysis.

[14] For instance, a recent report states that the big four banks hold about 81% of all outstanding home loans in Australia. Among new home loans written, their share is 93% to owner-occupiers,

Figure 4.3: Spread between bank loan and government bond yield. SA: Bank lending rate. SB: Business loans under A$2m. SC: Business loans above A$2m.



supply side factors in the bank loan market, instead the movements in price of alternative forms of finance: bank loans and bonds, are looked at from a macro point of view to see if they are materially different. A finding that the difference between these two rates fluctuates will lend credence to the view that the market for bank loans is separate from the market for bond finance, and that the influence of the bank lending channel changes as market circumstances change. Estimation results here will add to the stock of knowledge about the operation of this channel in Australia.

In the rest of this chapter, section (4.2) examines the literature on the bank lending channel. The estimation method and data are introduced in sections (4.3) and (4.4). Results are discussed in section (4.5). Section (4.6) concludes.

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and an astounding 97% for property investors. See Sydney Morning Herald (2011).

4.2 Literature review

Since Bernanke and Blinder (1988) outlined the theoretical foundation of the bank lending channel, many empirical studies have sought to measure it. Early studies, such as Bernanke and Blinder (1992), use the VAR method to see if different monetary measures and policy indicators had any relationship with a number of macroeconomic variables in the United States. Their results provide plausible evidence for a bank lending channel. But this kind of study which looks at the timing of changes in macroeconomic variables suffers from an identification problem because the effects of both the balance sheet of firms on the demand side and bank lending on the supply side are basically identical.

There are two preconditions of the bank lending channel mentioned in Bernanke and Blinder (1988), namely that the supply of bank loans is affected by reserve balance requirements, and that some firms are not able to substitute from loans into other sources of funding costlessly. Both have been the subject of empirical tests for the bank lending channel. Kashyap, Stein, and Wilcox (1993) introduce the 'mix' variable, the proportion of bank loans in total firm finance, to test whether bank loans are more or less dominant for American businesses in episodes of monetary tightening. If effects of monetary policy operate only to influence aggregate demand in the economy, then firms should have no need to shift the makeup of their finance. In their study they do find evidence in support of a bank lending channel in that the proportion of finance obtained from the market rises as monetary policy is tightened.

The problems for firms in obtaining finance are usually attributed to market imperfections. Due to incomplete information in credit markets, smaller firms frequently find that accessing market finance carries prohibitive costs. This observation is the main idea behind a study by Oliner and Rudebusch (1995), who maintain that the findings of Kashyap, Stein, and Wilcox (1993) may be driven sim-

ply by the heterogenous responses of firms that themselves have different degrees of reliance on bank finance. Specifically, small firms tend to rely more on banks for their financing needs, and are less able to buffer themselves than larger ones from contractions in credit. That alone, the authors argue, is enough to produce a drop in the fraction of bank finance in a monetary tightening. More generally, there is theoretical grounding to look at the possibly different responses to monetary policy changes from firms of varying sizes. A bank lending channel may be more influential for small firms than big ones. Empirically, apart from Huang (2003) discussed in the last section, Gertler and Gilchrist (1994), with aggregate data in the US, find that small manufacturing firms suffer much more financially than large ones when monetary policy is tightened. Vermeulen (2002), with data of four large European countries from 1983 to 1997, finds strong support for the view that smaller firms have problems with obtaining finance compared to larger ones.

This line of reasoning, however, can also be applied to banks, and provide other hypotheses for testing. Kashyap and Stein (2000) assemble a very large panel of US bank data from 1976 to 1993 and look at whether banks themselves also face constraints in supplying bank loans. The idea behind this test is similar in spirit to firms – that banks also face problems with asymmetric information, and weaker ones find it hard to substitute between sources of funding. Their empirical exercise focusses on the effect of bank balance sheet conditions and bank size on loan supply. They find that monetary policy changes do induce changes in bank loans, and that small banks, particularly ones with less balance sheet strength, are affected more. The authors conclude that the bank lending channel is functioning. Even though they do not make precise quantitative measurements of these effects, it is nevertheless pointed out that they can potentially be substantial.

Since the implications of the balance sheet and bank lending channels with regard to monetary policy changes are very similar, it raises problems with identifying whether the observed effects are due to either channel. With Kashyap and Stein (2000) being the prime example, many studies seek to build panels of data to exploit

the different responses to monetary policy from banks of different sizes, and try to see if they exhibit the behaviour predicted by the bank lending channel.[15] The typical strategy is to estimate a particular rendition of the loan supply function based on the ideas laid out in Bernanke and Blinder (1988), and the identification problem with bank loans data is solved if the panels include a large number of heterogeneous banks, since results can provide a useful contrast between banks of various sizes, states of health, market share, regions, and financial connections with other firms or banks. Some examples of such studies are Gambacorta (2001), Worms (2001), Farinha and Marques (2001), Brissimis and Delis (2009), Golodniuk (2006), Haan (2001), Topi and Vilmunen (2001) and Takeda, Rocha, and Nakane (2005). They all conclude in favour of a functioning bank lending channel for the countries they study.

Reflecting on the financial crisis that started in 2007, Freixas and Jorge (2007) present a theoretical model that looks at the interbank market and tries to explain some empirical findings that have been difficult to understand. The model shows that the magnitude and liquidity effects of monetary policy can be rationalised by looking at frictions within the interbank lending market, which other earlier models assume to be completely efficient. This shows that the interbank market is not as efficient as first thought (which is particularly true in economic downturns) and there is very likely to be a 'bank lending channel' of sorts in operation as commercial banks are large and active participants in the interbank market.

The evidence on Australia is scant. Studies that have looked into the transmission of monetary policy to the real economy typically only take account of the credit channel, without distinguishing between the balance sheet and bank lending channels.[16] Two attempts most related to studying the bank lending channel are

[15] The balance sheet channel is silent on the responses of individual banks.

[16] The Reseve Bank of Australia has made many studies down the years that make reference to the credit channel, but few make the distinction between a balance sheet and bank lending channel within it. See for example Stevens and Thorp (1989), Blundell-Wignall and Gizycki (1992), Tallman and Chandra (1996), Brischetto and Voss (1999), Beechey, Bharucha, Cagliarini, Gruen, and Thompson (2000), Stone, Wheatley, and Wilkinson (2005), Berkelmans (2005) and Nimark (2007).

Suzuki (2004) and Tallman and Bharucha (2000).

Suzuki (2004) suggests that if the reaction of bank loans to a tightening of monetary policy primarily comes from the bank lending channel, then overall loan supply should contract and loan interest rates should rise. The paper tests this hypothesis with data from 1985 to 2000, and concludes that changes in bank loans primarily work through a dominant interest rate channel. The reason is because in response to a rise in the policy interest rate, the price of loans drops. This drop in price reflects the drop in loan demand overpowering the tendency for price rises generated by the contracting supply of bank loans. In a separate estimation, total foreign currency liability is investigated. The author finds that foreign funding for Australian bank loans rises after monetary policy is tightened, implicating that the bank lending channel for transmitting contractionary monetary policy is mitigated by the inflow of funds. However, one potential problem with this study is that the price of loans is proxied by a diffusion index calculated from an Australian Chamber of Commerce and Industry survey on the difficulty in obtaining finance. For the sample period (in fact the entire life of this survey which started in the 1960s), this index exhibits a regular upward trend, pointing to more difficult financing, and taken as higher loan prices in the estimation. This upward trend may reflect ongoing bias from the respondents, and makes this index an unsatisfactory proxy for the price of loans, since official interest rates have gradually fallen during that period.

Tallman and Bharucha (2000) use data from the 1986 to 1993 credit cycle to investigate whether there was a credit crunch in Australia. Due to the lack of data, this study focusses on the direct observation of bank balance sheet information and builds its case on descriptive evidence. The authors argue there is weak circumstantial evidence that the supply side of credit was important in the recessionary period of the early 1990s, and banks that suffered more from NPLs had restrained credit more so than healthier ones. This suggests what Peek and Rosengren (1995) call a 'capital crunch' has happened to Australian banks in that period, lending

itself to arguments that a bank lending channel may be in operation.

4.3 Empirical method

The empirical approach taken here is based on analysing changes in the spread between bank loan rates and bond rates. The intuition derives from the structural model in Bernanke and Blinder (1988) that with the bank lending channel functioning, then firms are only able to switch between bank and bond finance with some degree of difficulty. The implication is that the cost of looking for bank loans and issuing bonds are suffciently far apart. Studies that directly estimate the loan supply function have to rely on heterogeneous bank or firm level data to identify supply side effects, and thus to provide clues on the response of these entities to monetary policy changes. Due to the lack of data on individual Australian banks and firms, this study is not able to examine changes in the borrowing and lending behaviour of individual entities of different sizes and health. Instead aggregate data on variables implied by the Bernanke and Blinder (1988) model are used in attempt to explain movements of the spread.

That conditions in the Australian banking sector can be affected by economic policy, and in turn influence macroeconomic conditions is demonstrated by VAR studies in Suzuki (2004) and Berkelmans (2005). In the former, it is demonstrated that deposits, loans as well as foreign currency liabilities all respond positively to innovations in the policy interest rate, and endogenously they have an effect on unemployment. In Berkelmans (2005), a counterfactual exercise finds that if unchecked by monetary policy, a 1% positive impulse to credit volume in Australia can generate rises in output by up to 0.6% after one year. It also concludes that responses of credit volume and inflation are somewhat slow to changes in the policy interest rate.

The specific version of the Bernanke and Blinder (1988) model suitable for Australia must reflect the asymmetry between the bond and loan markets. It must

also describe the particular feature of the Australian banking landscape, that since deregulation in the 1980s borrowing from foreign sources acted as another source of funds for the banking sector, and had an increasing role in the Australian economy. The model starts with five basic equations, which can be reduced to a set of equilibrium conditions in the output and money markets and contains the spread between the bank loan rate and the bond rate.

$$L^d = a_0 - a_1(\rho - i) + a_2 y \qquad a_{1,}a_2 > 0 \tag{4.1}$$

$$L^s = b_0 + b_1(\rho - i) + b_2 D + b_3 F \qquad b_1, b_2, b_3 > 0 \tag{4.2}$$

$$L^d = L^s = L \tag{4.3}$$

$$D = c_0 - c_1 i + c_2 y \qquad c_{1,}c_2 > 0 \tag{4.4}$$

$$y = d_0 - d_1 i - d_2(\rho - i) \qquad d_1 > d_2 > 0 \tag{4.5}$$

where:

L is log of real loans

D is log of real deposits

F is log of real foreign currency liabilities

y is log of real output

$\rho - i$ is the spread between the bank loan rate ρ and the bond rate i.

Equations (4.1) and (4.2) describe the demand and supply of loans. Loan demand is negatively related to the spread: a higher spread signifies a higher loan rate relative to bond finance, and higher output is associated with higher loan demand. The converse is true for the supply of loans: a higher loan rate induces banks to

make more loans available. Increases in deposits and foreign currency liabilities – main sources of funding for banks – can also add to the loan supply. Equations (4.4) and (4.5) describe the money and goods markets respectively. In equation (4.4), deposits are negatively related to the bond rate, because it reflects the cost of holding bank deposits, and positively related to income. With equation (4.5), production in the economy is dependent on access to finance, hence output is associated negatively with bond rates. The interest rate spread is supposed to reflect imperfections in money markets, where some firms are not able to switch costlessly between obtaining funding from banks and the market. Such imperfections impede on the ability of firms to produce, hence a positive measurement reduces output. For example, a high spread reflects higher cost for loans relative to bonds, so firms that rely more on bank loans must reduce producton and bring down output. Notice that if there is absolutely no difference between the bank loan and bond markets, then the spread will be zero. Here, total wealth, the interest rate for and level of deposits are assumed to be constant and exogenously fixed. Since deposit interest rates do not affect the analysis, it is suppressed to zero.

The empirical strategy involves estimating the loan supply function that results from a reduced form of the Bernanke and Blinder (1988) model. This set of conditions is arrived at by using equations (4.1), (4.4) and (4.5). The equilibrium demand condition is formed by taking equation (4.5) and substituting i and $(\rho - i)$ away, by using equations (4.1) and (4.4).

From equation (4.1), an expression for the spread is:

$$(\rho - i) = \frac{a_0}{a_1} + \frac{a_2}{a_1} y - \frac{1}{a_1} L,$$

and from equation (4.4), the interest rate for bonds is found:

$$i = \frac{c_0}{c_1} + \frac{c_2}{c_1} y - \frac{1}{c_1} D.$$

Substituting them into the goods market equation (4.5) results in the equilibrium

demand condition,

$$y = g_0 + g_1 D + g_2 L. \tag{4.6}$$

The loan supply equation is simply equation (4.2), rearranged so that the spread $(\rho - i)$ is on the left hand side.[17]

$$(\rho - i) = h_0 + h_1 D + h_2 L + h_3 F. \tag{4.7}$$

where:

$$g_0 = (d_0 - d_1 c_0/c_1 - d_2 a_0/a_1)/(1 + d_1 c_2/c_1 + d_2 a_2/a_1),$$
$$g_1 = (d_1/c_1)/(1 + d_1 c_2/c_1 + d_2 a_2/a_1),$$
$$g_2 = (d_2/a_1)/(1 + d_1 c_2/c_1 + d_2 a_2/a_1);$$
$$h_0 = -(b_0/b_1),$$
$$h_1 = -(b_2/b_1),$$
$$h_2 = 1/b_1,$$
$$h_3 = -(b_3/b_1),$$

and:

$$g_1, g_2 > 0,$$
$$h_1 < 0,\ h_2 > 0, h_3 < 0.$$

Finally, substituting D from equation (4.6) into the loan supply equation (4.7) results in the representation used for estimation:

$$(\rho - i) = j_0 + j_1 y + j_2 L + j_3 F, \tag{4.8}$$

with:

$$j_0 = h_0 - \tfrac{h_1 g_0}{g_1},$$
$$j_1 = h_1/g_1,$$

[17] This reduced form formulation is similar to the one employed in Brissimis and Magginas (2005). However, as will be made clear below, the estimation strategy here is different.

$$j_2 = h_2 - \frac{h_1 g_2}{g_1},$$
$$j_3 = h_3,$$
$$j_1 < 0,\ j_2 > 0,\ j_3 < 0.$$

Due to some practical reasons, there is a chance a non-zero spread will be maintained (either bank loans or bonds being more expensive) even without influence from the bank lending channel. Such problems may include differences in real life in the depth of the markets for bonds and borrowing from banks, the clientele these markets attract (such that a risk premium may be present), the possibility that regulations differ between markets, and from problems with gathering necessary and comparable data (such that a premium related to different term structures of securities comes into existence). However, variations in the difference between the loan and bond rates can signify a change in market conditions for bank loan and bond financing due to asymmetries between these markets. In other words, changes in the strength of the bank lending channel should lead to changes in the wedge that may exist. Regressing movements in the spread through time with movements of the structural variables in equation (4.8), in other words, their first differences, will give us an indication of the potency of this channel:

$$\Delta(\rho - i) = j_1 \Delta y + j_2 \Delta L + j_3 \Delta F, \tag{4.9}$$

again with $j_1 < 0,\ j_2 > 0,\ j_3 < 0$.

4.4 Data

The data used in the estimations are quarterly measurements of log real GDP, log real deposits, log real bank loans, log real foreign currency liabilities of banks and the spread (equal to bank loan rate - bond rate). Except for the spread, the series are discounted by the CPI. Since the literature has opined of varying difficulties for different firms or households to access finance from banks, it makes sense to estimate

with different categories of bank loans. In this study, aggregate series for total commercial loans and business lending under and above A$2m are used. The GDP data used are seasonally adjusted, but the others are not. Using seasonal dummies to run regressions for each of the dependent and independent variables, none of them display any seasonal pattern. Hence seasonally adjusted GDP data will be more appropriate for estimation as white noise introduced by seasonal patterns are avoided. For more details of the data sources, their time spans, and construction of the variables, please see Appendix E.

The construction of the spread and loan variables requires some clarification. Given the consideration on this model is on the difference between firms obtaining finance from the banks and from markets, in constructing the spread variable the bond rate used should ideally be a corporate bond yield. However, reliable data on Australian commerical bond yields are only available from the Reserve Bank of Australia (RBA) from 2000 onwards.[18] To find a substitute, notice that there is reason to believe corporate bond yields track those of government bond yields, as many commercial bonds are indexed to the government treasury bill rate plus a risk premium. From year 2000 until the end of the estimation horizon in 2007, five-year government bond and commercial bond yields for AAA, AA and A graded firms are all highly correlated, with correlation coefficients at around 0.95.[19] Since government bond yield data stretch much further back, it will be used as a proxy for commercial bond yield in this study.

Different bank loan rates are used, where possible, to match the corresponding bank loan series as closely as possible. For example, as a proxy for large and small firms, different rates are used for large and small business loans (above and below A$2m in value). The aim is to compare what effects the bank lending channel has on different sections of the economy, for example larger businesses, which are

[18] There is also a problem with data reported by the Reserve Bank of Australia in that the categories of bonds issued change over time. It is thus difficult to construct a coherent series of data for estimation.

[19] Author's calculation. Source for corporate bond yields is Reserve Bank of Australia Table F3.

supposed to have easier access to capital markets. To match with total commercial loans, the spread variable SA ideally should be constructed using the loan rates for all commercial loans. Among the available sources of data, the 'bank lending rates' series from *International Financial Statistics* (IFS) is considerably longer than the RBA data, and for this reason is used for analysis. Notice that the IFS series mainly contains rates charged by banks on loans to large businesses, but the IFS does not give a definition of the size of the companies considered, nor the method of averaging to arrive at the rates.[20] The method of data collection and calculation is most likely different to the shorter series published by the RBA used in constructing spread variables SB and SC. An artefact of the different ways of calculating the loan rates is reflected in Figure 4.3, where SA displays a trajectory higher than either the small or large business loans rates in SB and SC for the second half of the estimation horizon. Nevertheless, the fluctuations of all three spread series are very similar.

The shorter RBA series also does not define a boundary between 'large' and 'small' firms. There is however a division of business loans according to dollar amounts. Given the lack of access to data on bank loans of individual entities, the size of bank loans is taken as a surrogate for large and small firms, as large firms are likely to ask for larger loans. The highest category provided by the RBA, loans of A$2m or more, is separated from others below A$2m in an arbitrary partition in this study. Notice the A$2m demarcation is not adjusted for the price level throughout the series, so given persistent inflation in Australia since the start of the estimation horizon, this bar gets progressively lower in real terms. As loans generally get bigger alongside prices over time, this series grows much faster than the under A$2m series. The loan rates data reported are weighted averages of fixed and variable rates loans.[21]

[20] See International Monetary Fund (2011). In any case, large businesses have more scope to ask for larger loans, so in any data series that purport to represent total business lending volumes or rates, one can expect the effects of loans to large businesses to dominate.

[21] The exact method as given by the Reserve Bank of Australia is that the "'[w]eighted-average interest rates' are calculated ... using the midpoint of each interest band [of 1%], except for the lowest and highest bands where half a percentage point is deducted and added, respectively. The

Due to issues with the availability of data, the regressions start at different dates and will be labelled in the results section. It was in February 1985 when the Australian banking sector deregulated and freedom to borrow in foreign currency granted. In view of the fact that foreign currency borrowing is such an important part of the Australian banking landscape, estimation should ideally start at this date. However, due to problems with finding adequate matching data on bank loan volumes and loan rates, this study takes 1990Q1 as a start date when meaningful data on commercial loans is first available.[22] The end point for this study is 2007Q4. Bank loans series on large and small business loans only start in 1993Q4, but are still used on the premise of theoretical background. These time frames make 72 and 57 observations available for estimation respectively. While it is best to have longer time series data to enlarge the sample size, the existing data should still allow estimation results to be trusted.

In the last three decades, the Australian financial markets went through many changes, the banking sector itself was opened up to international competition, plus the economy underwent other disturbances. It is possible that these changes have altered the way the economy functions, and the effects that monetary policy has on the economy.[23] To see whether the estimations are subject to potential disturbances brought about by the changes in regulatory regime and economic environment, the Quandt-Andrews test is carried out on each estimated equation to examine the possibility of structural breaks.

4.5 Estimation results

Estimation results for the four data sets are presented in Table 4.1. In all, estimation for three versions of equation (4.9) are reported. The coefficients of the regressions

calculation excludes impaired loans."

[22] The only bank loan rates series available from 1985 onwards is the one in International Financial Statistics. However, commercial loan volumes data only start in 1990. There is no correspondent bank lending rates series for total bank loans and advances data that is available from 1985.

[23] See Appendix F for a discussion of such changes.

are reported in the columns and if significant at the 5% level, starred. A number of AR terms are included in each estimation to tackle the problem of serial correlation and listed in the table. Correlograms are inspected and the Breusch-Godfrey test is carried out to ensure there is no problem. The numerous individual graphs and test statistics in this process are not reported here. P-values for the other diagnostic tests are reported: the Quandt-Andrews test is used to assess whether estimated equations contain structural breaks; the White test for heteroscedasticity is also reported, and where significant, White's heteroscedasticity consistent standard errors are used to assess the significance of the coefficients. Two fitted terms of the Ramsey RESET test are reported in testing for misspecification problems.

As described in Section (4.4), in total three spreads are used. Respectively, they are:

SA = Bank lending rate - 5-year government bond yield

SB = Loan rates under A$2m - 5-year government bond yield

SC = Loan rates above A$2m - 5-year government bond yield

In each regression, the spread is run against the independent variables: change in log real output, change in log real loans, and change in log foreign currency borrowing. While there is reason to suspect these variables to be multicollinear in levels, their first differences do not share such concerns. None of the independent variables or their lags have correlation coefficients over 0.35, so there is no issue with multicollinearity in the estimations here.

Table 4.1 reports a basic estimation with contemporaneous values, and other more parsimonious representations that may contain lagged values of independent variables. Lagged values are included because of the possibility of time lags in the effects of these variables on the spread. Since the estimation is essentially looking into imperfections in the market for external finance, it is sensible that such variables may take some time to affect the spread. As quarterly data is used, estimations will take into account only the first lags – in financial markets two lags (six months) is an implausibly long time for any influence of note to be considered. Notice that

with the equation of the output market (4.6), deposits and loans may be associated with output with a lag also. Since equation (4.9) contains the equilibrium in the output market as well, lagged deposits is also included (bank loan volume is itself already an independent variable of equation (4.9)).

In Regression 1, total commercial loans are used against the dependent variable SA, and the time horizon starts in 1990Q1. This series of commercial loans includes bank loans to other banks, NBFIs, un/incorporated companies, non-profit, government and private entities, and starts in 1990Q1.[24] In Regression 1a, both the contemporaneous and lagged foreign currency liability are significant, as is lagged deposits, but other terms are insignificant. After dropping the insignificant output and loan terms, in Regression 1b both current foreign currency borrowing and lagged deposits are significant. Adjusted R^2 is almost the same even with so many dropped terms. Since the series for the independent variables are not multiplied by 100, the coefficient of $\Delta deposit_{t-1}$ says that if the change in lagged deposits rises by 1%, then the change in the spread will be negative 0.07759% (7.759 basis points). In the context of the model employed here, this is in line with the idea that larger deposits should depress lending rates and eventually reduce the spread. A narrowing spread points to the bank lending channel reducing in strength, as that is an indication of less asymmetry between the bank loan and bond markets. Even though it is smaller in magnitude compared to lagged deposits, the coefficient for ΔFCL_t is positive, contrary to theory. The results indicate a positive rise in the change of foreign currency borrowing widens the spread by about three and a half basis points. This may mean that instead of increased foreign currency borrowing relieving the pressure on bank loan rates instantaneously and hence depressing the spread, this increase coincides in timing with rising demand for bank loans, so the estimation picks up a rising spread together with rising foreign currency borrowing in the financial system. This suggests foreign funds take time to affect the Australian financial markets.

[24] See Appendix E for more information.

Table 4.1 Regression Results

Regression	1a	1b	1c	2a	2b	2c	3a	3b	3c
Start of time horizon:	1990Q1	1990Q1	1990Q1	1993Q4	1993Q4	1993Q4	1993Q4	1993Q4	1993Q4
Dependent variable:	SA	SA	SA	SB	SB	SB	SC	SC	SC
Independent variables:									
$\Delta Output_t$	-3.695			-1.071			-2.268		
$\Delta Loan_t$:									
Bank loans									
Commercial lending	0.841								
Business lending under A$2m				-1.907					
Business lending above A$2m							2.002		
ΔFCL_t	4.523*	3.486*	2.694*	3.465*	3.682*	2.965*	3.582*	3.283*	3.146*
$\Delta Output_{t-1}$	11.085			17.453*			18.181*		
$\Delta Deposit_{t-1}$	-10.624*	-7.759*		-11.637*	-7.134*		-9.698*		
$\Delta Loan_{t-1}$:									
Bank loans									
Commercial lending	2.278								
Business lending under A$2m				0.728					
Business lending above A$2m							-1.565	-2.861*	
ΔFCL_{t-1}	-2.955*		-2.519*	-1.435		-2.242*	-9.698*		-2.164*
AR terms included	1,2,3,4	2,4	4	2,4	2,4	2,4	1,2,3,4	2,4	2,3,4
Adjusted R^2	0.295	0.272	0.241	0.256	0.371	0.299	0.407	0.262	0.337
Quandt-Andrews test	1.000	1.000	0.990	1.000	1.000	1.000	1.000	0.965	1.000
White's test	0.978	0.523	0.838	0.353	0.007*	0.106	0.359	0.833	0.157
Ramsey RESET test:									
1 fitted term	0.520	0.337	0.259	0.563	0.468	0.917	0.423	0.915	0.674
2 fitted terms	0.636	0.412	0.120	n/a	0.345	0.212	0.444	0.487	0.216

Definition of Spread: SA =(Bank lending rate - 5 yr government bond yield); SB =(Loan rates under A$2m - 5-yr government bond yield); SC =(Loan rates above A$2m - 5-yr govt bond yield). The start of the estimation horizon is indicated for each regression, they all end in 2007Q4. A star indicates significance at the 5% level for regression coefficients of the independent variables. Values reported for diagnostic tests are p-values. Figures smaller than 0.05 indicate rejection of the null. The White test is for heteroscedasticity, if the null of homoscedasticity is rejected, then White's Heteroscedasticity consistent errors are used to assess significance. The Quandt–Andrews test is for structural breaks, with the null of no break in the equation. Two fitted terms are used for the Ramsey RESET test for misspecification, with 'n/a' representing a test that cannot be carried out.

In Regressions 2 and 3, different series for bank loans below and above A$2m and their corresponding average lending rates are used for estimation. The time horizon is somewhat reduced and only starts in 1993Q4. Regression 2a includes contemporaneous and lagged terms of independent variables, and here current foreign currency liability, lagged deposits as well as lagged output are significant, and the bank loan terms are again insignificant. Similar to Regession 1b, once progressively dropping insignificant terms, Regression 2b finds $\Delta deposit_{t-1}$ and ΔFCL_t to be significant, with the same signs and even similar magnitudes. One suspects the same mechanism is at work with lagged foreign currency borrowing in this segment of the economy as in Regression 1: for small firms which borrow small amounts, a rise in deposits weakens the strength of the bank lending channel; meanwhile the rise in banks' foreign currency borrowing coincides with pressure in the loan market and rising spread.

Regression 3 is simply the above A$2m analogue of Regression 2. It is done to provide insight to the claim that large firms tend to have better access to capital markets, and have more options in raising finance (which may include loans and bonds, as well as flotation in the stock market). That way, aggregate volumes in the bank loan market ought to have a smaller impact on such firms. With all terms included, Regression 3a finds current and lagged foreign currency liability, lagged deposits as well as output significant. However, further reduction results in Regression 3b, showing only ΔFCL_t and lagged loans $\Delta Loan_{t-1}$ to be significant. Moreover, both have signs that do not adhere to theoretical prediction. Contrary to Regression 2b, lagged deposits is not significant for large loans, and the negative lagged loans coefficient means that when bank loans are growing, the spread will decline. A rise in the change of lagged loans by 1% actually narrows the spread by 2.861 basis points. A plausible explanation may have to do with larger and more reputable firms obtaining more loans at lower rates. Perhaps that is due to banks preferring to increase lending to large firms at cheaper rates, at the expense of small loans which are mainly made to smaller firms. This result corroborates

with the finding in Huang (2003) that big firms get more credit at the expense of smaller firms. In any case, inspection of the large loans data reveals lending rates to be consistently lower than smaller loans.

There is a trend in all three regressions that more foreign currency borrowing by the banking sector coincides with a widening spread in the same period. While that may be explained by banks responding to increasing tightness in the Australian loans market by immediately borrowing from overseas, it is interesting to see whether through the passage of time there is a reduction in the spread due to this borrowing. In Regressions 1a, 2a and 3a, ΔFCL_{t-1} is negative after positive values are reported in the contemporaneous terms, but the lagged term eventually drops off as it becomes insignificant. Regressions 1c, 2c and 3c include only foreign currency liability and its first lag to give a clearer idea of the effects of foreign currency loans. All three results show that foreign currency loans are associated with a widening spread in the current period, but after one quarter it narrows down substantially. If it is admissible that foreign currency liability rises in tandem with bank loan rates reflecting a shortage of local funds in the bank loan market, then it seems that after one quarter the increased supply of loans does relieve pressure on this market. This interpretation suggests foreign sources of funding act as a pressure valve to the Australian banking sector after a lag, bringing down loan rates which are otherwise rising. In other words, the introduction of foreign funding reduces the strength of the bank lending channel after a period of time. This conclusion is in agreement with the finding in Suzuki (2004).

Taking stock of all the evidence together, it seems that for Australia conditions in the banking sector, as measured by the structural variables suggested by Bernanke and Blinder (1988), namely aggregates in output, deposits, loans and foreign currency liabilities, do affect the markets for bank loans and bonds differently. The positive association of contemporaneous foreign currency liability and the spread is almost entirely reversed after one quarter. As discussed in Batten (1997), foreign

currency funding increases in line with the rising openness of the economy, so it is possible that given persistent current account deficits in Australia throughout the estimation horizon, foreign currency liability augmented the supply of funds, and is able to decrease lending rates after a delay, reducing the strength of the bank lending channel in the process. With total commercial loans, larger deposits are related to a narrowing spread, in accordance with theory that a bigger deposit base reduces bank loan rates. Small business loans share the same result. These point to the bank lending channel being stronger when deposits shrink. However, the segment of the market for large bank loans seems to operate with a different mechanism, with loans instead of deposits being a driver of the spread, and higher growth of loans lead to a narrowing spread. This trend lends itself to the interpretation that larger firms have better access to bank financing. Throughout the estimation horizon in the 1990s and 2000s, the growing economy seems to be related to a rise in the volume of large loans as well as a drop in lending rates compared to financing by bonds.

4.6 Conclusion

Over the past decade, many studies have been made about the bank lending channel in different parts of the world, to paint a better picture of how monetary policy is transmitted through the banking system in different economic and institutional environments. The evidence on Australia is not rich: the only previous contribution is Suzuki (2004). However, the result that the bank lending channel does not dominate the traditional interest rate channel in transmitting monetary policy cannot answer the question of how strong it is and what factors can influence its strength. This chapter is an Australian addition to the literature, and extends the evidence on a bank lending channel by making use of readily available macro

time series data. Since the 1980s, the Australian economic landscape has changed enormously from steps to deregulate financial markets and the banking sector, resulting in large flows of foreign funding for both firms and banks. If markets are well developed and efficient, there should be very little difference between bank lending and market financing, giving bank loan volumes little role in the transmission of monetary policy. Therefore there should not be any movement in the spread between bank lending rates and bond rates as financial aggregates in the banking sector change.

The contribution of this chapter is to test the strength of the bank channel in Australia, with a particular focus on the financing of firms. Given that markets are in general not efficient, the results here indicate that the strength of bank lending channel drops when the deposit base rises in real terms. The implication is that for the time period between 1990 to 2007, firm financing is likely affected by monetary policy through the volume of bank loans available. Also, the mechanism in operation is different between large and small loans, which loosely proxies for large and small firms. These findings may suggest that larger firms, which generally take out larger bank loans, are beneficiaries from more bank loans and at lower interest rates – a conclusion consistent with the notion that firms in general do not switch frictionlessly between bank loans and bonds, in particular smaller firms face more difficulty in obtaining finance. A perculiar feature of the Australian financial market since the 1985 is the increasing inflow of foreign currency borrowing as a source of funding. In agreement with Suzuki (2004), this new source of funds is found to reduce the strength of the bank lending channel after a one quarter lag by closing down the spread between bank loan and bond rates. The relationship between monetary policy and commercial loans is worthy of further research, as other authors also find results that deserve more investigation. For example, den Haan, Sumner, and Yamashiro (2007) find that in the US, when monetary policy is tightened, mortgage and personal loans respond negatively, but the volume of

commercial loans rise.

It must be noted this study is simplistic in many ways. For example, with the simple formulation used in this chapter, it is possible that some of the macroeconomic variables used as regressors may to some degree be endogenous. Potentially this can bias the results, but the usage of lagged independent variables here can go some way in addressing this problem. To extend the scope of this study, more disaggregated data on large and small firms can allow refinement of the estimations in Regressions 2 and 3. More exhaustive evidence may also be obtained by building panels of individual bank responses, but this requires a larger number of banks. While information maybe be lost at the aggregate level, the fact that not that many banks operate in Australia mitigates this problem, in the sense that four large banks form the bulk of the banking sector.[25]

Due to problems with data, corporate bond yields are not obtainable and proxies must be used for the estimations. Nevertheless, this study is able to provide indirect evidence that financial markets are not yet efficient, and to the extent that bank lending is a unique source of funding in environments without completely frictionless markets, the bank lending channel reduces in strength when the deposit base becomes larger, and when more foreign funding is introduced. As results here point to different mechanisms working for large and small firms, future research may focus on uncovering more details on their dissimilarities. Further studies in this area may be able to benefit from the continued accumulation of bank and firm level data for panel estimation, or more reliable series of corporate bond yields data. Alternatively, smaller institutions, such as credit unions and mortgage finance companies maybe included for estimation, extending the analysis to the mortgage and personal loans market. An extension to studying the bank lending channel may be to concentrate on the interbank market, since there is an increasing number of financial institutions that deal in this market for their funding. However, these

[25] It will especially be the case now since the fifth largest bank (St. George Bank) has merged with one of the big four, Westpac.

institutions are very much dependent on commercial banks participating in providing short term interbank funding. In this sense, bank loans take on a different importance to the economy.

Chapter 5

Conclusion

Episodes of large negative shocks to the economy, like the bursting of the bubble in Japan in the 1990s, or the turbulent events on financial markets since 2007 give rise to lots of non-performing loans (NPLs) in the banking system, in the process raising awareness in the ways banks deal with them. NPLs has always been an important consideration for banks in their daily operations, since it relates to how much loss they may suffer, and to the quantity of bank loans supplied. One particular topic in the spotlight is the impact on the macroeconomy given the way banks tackle their problem loans. Also important is the way monetary policy is transmitted through to the banking sector to the macroeconomy. Whether changes in official interest rates impact on the economy by influencing the demand for bank loans by consumers and businesses, or its supply through the lending behaviour of banks, monetary policy continues to exert a heavy influence on the banking sector.

5.1 Bank treatment of NPLs

Chapters 2 and 3 investigate the actions of individual banks in dealing with their NPLs. The aim is to make clear the incentives that each bank faces, so as to enhance understanding of the considerations that enter a bank's decision-making process. The main thrust is that bank behaviour in disposal of NPLs is independent of concerns to the wider economy. Opinions that only focus on macroeconomic

concerns – whether to dispose of NPLs slowly or quickly, are not always appropriate as guides to how banks should proceed.

Chapter 2 uses a simple partial equilibrium framework to analyse the balance sheet of a typical bank, focussing only on profit maximisation and the capital constraint. By abstracting from the many factors that are outside the control of banks, the model provides a reason why banks in some circumstances choose not to adhere to either extreme opinion when dealing with bad loans. The results reflect that the comments which advocate either faster or slower write-off of bad loans are mostly not derived from the point of view of banks. Also, analysis of the capital ratio constraint reveals that to free banks from being constrained by capital requirements when clearing their bad loans, loan interest rates must be high enough to guarantee a good profit margin. The rationale behind this finding is that the capital adequacy ratio acts as a constraint to the disposal of NPLs, to a point where banks cannot dispose of all their loans even if it may be more profitable for them to do so.

Two implications of the model are that the losses from writing off NPLs can be covered by a high enough loan interest rate, and when capital regulation is tightened, banks with healthier balance sheets will have less need to respond by shrinking their lending activities. Higher loan interest rates increase the profit margin of a bank, and as the amount of NPLs grows, the interest income needed to compensate for losses upon write-off increases. The same holds for banks with less capital: higher loan interest rates are necessary to cover for the potential shortfall in capital upon write-offs. Therefore, forbearance of bad loans become more frequent under low loan interest rate and/or low bank capital ratio environments. When this insight is applied to Japan with its zero interest rate monetary policy, and generally low capital ratios among banks, it is clear why banks there dragged their feet with their NPLs in the 1990s.

It is also demonstrated that banks that are stronger in capital position will not need to respond as much as weaker counterparts in case capital regulation get more stringent. Weak banks that barely satisfy the minimum requirements are forced to

forbear more loans since liquidation will result in losses that contravene regulations. Well capitalised banks thus have more scope to choose a level of liquidation that brings them closer to their point of maximum profit. This result fits well with the observation in Japan in the 1990s – lots of forbearance of bad loans in a banking system with generally low capital ratios and low profitability.

In Chapter 3, once the analysis is extended to include interactions with collateral markets, many more insights are revealed. The most important finding is that by including the 'recycling channel' of bank lending in the model, it is possible that asset prices rise as a result of selling repossessed collateral in the market, and economic activity is boosted. This refutes the common opinion that firesales of collateral will heap pressure on asset prices and generate negative wealth effects. While this result may appear to justify the opinion that NPLs should be liquidated as quickly as possible to provide funds for new businesses, that is not necessarily so, because banks themselves may forbear for two reasons.

Another main finding of this chapter is that there can be two types of forbearance lending. The results show that there may be an optimal level of NPLs on banks' balance sheets due to profit maximisation alone, in which case it is detrimental to either force them to dispose of more or less NPLs. Any effort from either the 'liquidationist' camp or people who prefer a gradual restructuring to mitigate the NPLs problem is therefore unlikely to be helpful for the banking sector, unless it explicitly takes account of the profit motive of banks. The other reason for forbearing bad loans can be called 'health-induced forbearance', due to the losses from writing off impaired assets potentially putting banks in breach of capital regulation. This can happen if disposing of a bad loan generates a loss for the bank. Notice this is not the same as what is called 'regulatory forbearance' in the literature, which refers to a government decision to tolerate more bad loans in the banking system because of its potential cost to the overall economy.

It is shown in this chapter that different levels of the capital ratio can lead to different amounts of recycled bank lending and hence have different impacts on

collateral prices. In fact, lowering the minimum capital ratio requirement can increase asset prices. In the environment of this model, a lower capital requirement allows banks to free up more cash for new lending, allowing more new firms to enter the economy and therefore support asset prices. Notwithstanding practical difficulties in using the capital ratio as a countercyclical policy instrument, lowering the capital ratio does provide stimulus to the economy and asset market.

The above result can be applied to the context of Japan in the 1990s. Japanese banks had large amounts of NPLs from the prolonged slowdown, and suffered losses that threatened the viability of many of them. The Japanese regulatory authorities responded by allowing deferred tax assets to be considered as part of the capital of banks. The effect of this action is to artificially boost the capital ratios of loss-making banks, and is equivalent to lowering the capital requirement, so that they did not have to shrink their balance sheets. The support this action provides to the economy is in agreement with the conclusion from this model.

5.1.1 Possible extensions

The model employed here to look into the question of NPLs is partial in nature. This setup simplifies the analysis a great deal, so that focus can be given to the mechanics of how a typical bank will deal with its bad loans. While the models in Chapters 2 and 3 allow one to make inferences about how much NPLs to liquidate, resultant collateral prices and also the amount of bank loans supplied, an obvious issue that is of great interest is to find out the welfare cost to the economy when banks clear their NPLs. To do this may require the banking sector environment here to be incorporated into a general equilibrium framework. Doing so can allow policymakers to assess whether policies designed to help banks with the NPLs problems are useful.

This model may also be extended to look into the issue of stability of banks. In the environment here, banks are precluded from operating below the minimum

capital requirement. As a bank's capital ratio drops, its scope for liquidating bad loans progressively decreases, to a point where there is forearance of bad loans. If this environment is relaxed to allow for the bankruptcy of banks, then it introduces a new dimension to the analysis, in that NPLs can affect the economy not just by how much banks decide to liquidate, but also whether the banks themselves become insolvent. Such a scenario is not uncommon in the world, as many banks are often affected by bad loans to a point where their existence is threatened. Introducing this element into the model will allow analysis of the effectiveness of policies designed to mitigate systemic crises.

5.2 The bank lending channel in Australia

In Chapter 4 an empirical exercise is undertaken to find out about the strength of the bank lending channel in Australia. The bank lending channel concerns the transmission of monetary policy into the wider economy. Since the banking sector is a very important part of the economy in directing savings into investment, and bank lending is such a major, indeed sometimes unique, source of funding for many borrowers, it is necessary to find out how the market for bank loans will be affected by institutional changes in the financial sector. Of particular interest is whether firms which have better access to financial markets are less affected by variations in the supply of bank loans. This kind of study is much needed as the institutional backdrop of the financial services industry has undergone many changes since the 1980s.[1] Changes include the process of deregulation which allow banks to compete internationally for business and to engage in financing activities overseas. Coupled with continued financial innovation, these changes have resulted in the securitisation of erstwhile illiquid assets, and sustained growth in foreign currency borrowing in Australia. These developments lead one to question whether the influence of the bank lending channel may fluctuate, and if firms of different sizes are affected homogenously.

[1] See Bernanke and Gertler (1995) and Appendix F.

This chapter attempts to provide a contribution to the bank lending channel literature by studying Australia. For Australia, there has only been one study that dealt with the bank lending channel. The Suzuki (2004) finding suggests that the bank lending channel does not dominate the traditional interest rate channel. But this finding is not able to shed light on the fluctuations in strength of the influence exerted by the volume of bank loans circulating in the economy. Due to the lack of bank level data to build a panel that will allow identification of the loan supply function, the methodology employed here seeks to examine the potency of the bank lending channel by looking at the interaction between the prices of bank loans versus prices of bonds. The results here add to the Australian evidence given in Suzuki (2004) by ascertaining that the bank lending channel reduces in strength when the deposit base rises and when there is a rise in foreign funding for local economic activity. Also, the influence of the bank lending channel is stronger for small business loans (which can loosely represent smaller firms) than larger ones.

Given the concentrated nature of the banking sector in Australia, the use of aggregate data for estimation is quite representative of the behaviour of large banks, as the big four banks dominate overwhelmingly. This is particularly so when one considers commercial lending, as smaller banks tend to be more active in the mortgage market and less so in making commercial loans. However, if there is not data from another group of smaller banks for comparison, panel methods used in some studies for other countries cannot be employed. Here, estimations are carried out on different categories of business lending to see whether there is a material difference between the movement of interest rates charged on bank loans and those of bonds. If financial markets are always efficient, meaning firms can substitute between these two sources of funding without too much cost, then there should not be much movement in the difference between these two rates. A narrowing spread between these two points to relative ease in switching between sources of finance, in other words a reduction in strength of the bank lending channel.

With a number of different bank loans series data, the main finding is that in

Australia the operation of bank lending channel seems to be different between large and small loans. Results show that in the market for small scale commercial finance below A$2m, a larger deposit base can reduce lending rates and hence the spread, but only after a time lag. However for loans above A$2m, it is the volume of loans that have a negative effect on the size of the spread. This difference may reflect that banks prefer to lend to larger and likely more reputable firms, and charge lower interest rates when doing so. Another finding of this study, which broadly agrees with the findings of Suzuki (2004), is that foreign currency borrowing, an increasingly important source of funds for Australian banks, is associated with a widening spread contemporaneously, but narrows it after a one quarter lag, and it holds true for loans of all sizes. This likely means bank loan rates are rising just as foreign funds enter the banking system. Further analysis reveals that after a time lag, the extra funds will reduce loan rates and the spread declines. On the whole, these results show that larger firms, borrowers that are supposed to have better access to market finance than smaller counterparts, are affected less by the supply of loans. As well, foreign funding is an important factor that can reduce the tightness of funding, and hence the strength of the bank lending channel, in Australia for larger and smaller firms alike.

5.2.1 Possible extensions

In this study, the spread variable should ideally be constructed by taking bank loan rates and commercial bond yields, since the distinction is between bank loans and market finance, and participants in financial markets are mainly limited to firms. This is not possible in Australia as corporate bonds data are inadequate to form a usable data series for analysis. The use of government bond yield as a proxy, while highly correlated with corporate bond yields, nevertheless may mask important intertemporal divergences between yields from bonds issued by firms of different credit ratings. Future studies may be able to gather more exhaustive data on corporate bond yields of appropriate maturity to carry out the estimation. A

better classification of large and small firms, even if only in aggregate, can shed more light on the different mechanisms affecting large and small bank loans, as results here and among other studies are not always reconciliable with theoretical prediction. Having micro data on individual firms and banks can enable data panels to be built and provide insight into how monetary policy affects entities of different size and strength in the market for bank loans. The small number of banks that dominate in Australia ('the big four') provides a mitigating factor to the usage of macro time series data to proxy for their behaviour in this thesis, but extra information may be obtained if bank level data can be collected for a larger number of banks for estimation. Data from more categories of bank loans may also be used to provide clues on how different classes of banks and borrowers react to changes in monetary policy.

Appendices

Appendix A

Explicit solution for endogenous variables in Chapter 3

In section 3.3.2 of Chapter 3, a relation between M and P_0 in equation (3.12) is found from first order conditions. The corresponding expression for the CAR constraint case is equation (3.18). Solutions to variables in the bank's problem can be determined by using equations (holding with equality) for:

the firms sector (3.1),

$$q_0 k_0 = q_0 \tilde{k} + l;$$

loan size (3.2),

$$l = \frac{1}{R} E q_1 k_0 (1 - c);$$

and asset market (3.4),

$$q_0 = \frac{A}{R(K - P_{-1}k_{-1} + Mk_{-1} - P_0 k_0)} + \frac{Eq_1}{R}.$$

Using equation (3.1), an expression for k_0 is found:

$$k_0 = \tilde{k} + \frac{l}{q_0}.$$

Making use of expressions (3.11) and (3.17) for q_0, explicit solutions for k_0 are found.

Substituting the above into the loan size equation (3.2) gives an expression for Eq_1:

$$Eq_1 = \frac{Rl}{k_0(1-c)}.$$

Using the asset price expressions that result from FOCs in equations (3.11) and (3.17), and using Eq_1 above, one can find an expression that contains both M and P_0:

$$q_0 = \frac{A}{R(K - P_{-1}k_{-1} + Mk_{-1} - P_0k_0)} + \frac{l}{k_0(1-c)}.$$

Finally, making use of the relevant first order conditions equation (3.12) or (3.18) which contain M and P_0 with this asset price equation allows these two variables to be pinned down. Notice that the value of M can only be between 0 and N. Should the values of exogenous parameters put M outside this range, then a boundary solution is imposed.

The asset price q_0 and quantity of land under investment k_0 are determined in the market in aggregate, and as such, the process to solve them involves making use of the demand function for land equation (3.1), and the supply function given by equations (3.2) and (3.4). But the crucial point is that the price and quantity of land under investment is determined by the collective actions of the banking sector. That means the optimal M and P_0 found in the bank's problem should be used in this system. Since these same equations have been used in the bank's maximisation, plugging them back in will simply result in expressions (3.11) and (3.17) for the asset price, if both M and P_0 are interior solutions. If however the explicit solution of M is below 0 or larger than N, as determined by the exogenous parameters, then M must be set at $M = 0$ or $M = N$ and used to find the values of q_0 and k_0.

Appendix B

Proof of Proposition 1 in Chapter 3

Substituting l from equation (3.2) into equation (3.1), an expression for Eq_1 can be found:

$$Eq_1 = \frac{Rq_0(k_0 - k)}{(1-c)k_0}.$$

Putting this into equation (3.3) and rearranging gives:

$$q_0 = \frac{1-c}{R} \cdot \frac{k_0}{\tilde{k} - ck_0} \cdot H'(K - P_{-1}k_{-1} + Mk_{-1} - P_0k_0).$$

In this environment, the amount of investment per firm, k_0, is only determined by q_0 in the budget constraint (3.1). However, because individual banks are too small to affect the asset price, their individual decisions on liquidation are made without internalising it. That means k_0 is independent of M in the calculation of the derivative $\frac{\partial q_0}{\partial M}$.

The derivative $\frac{\partial q_0}{\partial M}$ is:

$$\frac{\partial q_0}{\partial M} = \frac{1-c}{R} \cdot \frac{k_0}{\tilde{k} - ck_0} \cdot \frac{\partial H'(\bullet)}{\partial(\bullet)} \frac{\partial(\bullet)}{\partial P_0} \frac{\partial P_0}{\partial M}.$$

Note from equations (3.12) and (3.18) that $\frac{\partial P_0}{\partial M} > 0$. Also, $\frac{\partial H'(\bullet)}{\partial(\bullet)} < 0$ from the

assumption of the marginal productivity of the asset holders. As well, $\frac{\partial(\bullet)}{\partial P_0} < 0$ and $\frac{1-c}{R} > 0$. So the sign of this derivative depends on the sign of $\tilde{k} - ck_0$. If the transaction cost for liquidation, as a proportion of receipt is smaller than the proportion of downpayment in new investment, that is, $c < \frac{\tilde{k}}{k_0}$, then $\frac{\partial q_0}{\partial M} > 0$. But if this cost is sufficiently large at $c > \frac{\tilde{k}}{k_0}$, then $\tilde{k} - ck_0 < 0$ and the $\frac{\partial q_0}{\partial M}$ becomes negative. That is the case because $\tilde{k}$ represents the endowment of new firms previously not used for investment. Its entry into investment serves to compensate the loss from liquidation.

Appendix C

Proof of Proposition 3 in Chapter 3

Consider first the case when the CAR constraint (3.14) is binding. In this case, the asset price is expressed in equation (3.17). According to Proposition 2, the CAR constraint only binds when $l - q_0 k_{-1}(1-c) > 0$. Substituting the corresponding q_0 into $l - q_0 k_{-1}(1-c)$ results in:

$$CRl\left[1 - \frac{\theta(1+i_0+i_1)}{\pi(1+i_1)}\right].$$

This expression can only be positive if $\pi(1+i_1) > \theta(1+i_0+i_1)$.

The partial differential of the asset price equation (3.17) with respect to minimum capital requirement is

$$\frac{\partial q_0}{\partial \underline{CR}} = \frac{l[\theta(1+i_0+i_1) - \pi(1+i_1)]}{\pi(1+i_1)k_{-1}(1-c)}.$$

Given $\pi(1+i_1) > \theta(1+i_0+i_1)$, this expression must be negative.

Now consider the case when the CAR constraint (3.14) is not binding. That means bank lending can go on until the cash constraint (3.8) binds. The asset price therefore equals $q_0 = \frac{\theta(1+i_0+i_1)l}{\pi(1+i_1)k_{-1}(1-c)}$, listed as equation (3.11) above. It is clear that changing the capital requirement will have no effect on bank behaviour if it does not become binding on banks.

Appendix D

Proof of non-negativity of M in equation (3.18) in Chapter 3

The expression for M is only sensible if it is positive. In the binding CAR constraint case, that expression is equation (3.18):

$$M = \frac{\pi(1+i_1)[z + (P_{-1} - N)i_0 l - \underline{CR} l(P_{-1} + P_0)]}{-\underline{CR}\theta(1+i_0+i_1)l}.$$

Since the denominator is negative, a sensible result for M requires the numerator to be negative, which boils down to proving the term in square brackets $[z + (P_{-1} - N)i_0 l - \underline{CR} l(P_{-1} + P_0)] < 0$.

A clue to proving this lies in the CAR constraint equation (3.14), which in the present case is binding:

$$[z + (P_{-1} - N)i_0 l] - M[l - q_0 k_{-1}(1-c)] = \underline{CR} l(P_{-1} + P_0) - \underline{CR} M l.$$

Rearranging, it becomes:

$$[z + (P_{-1} - N)i_0 l] - \underline{CR} l(P_{-1} + P_0) = M[l - q_0 k_{-1}(1-c)] - \underline{CR} M l.$$

The size of the left hand side can be found by considering the term $[l - q_0 k_{-1}(1-c)]$ on the right. As shown in Proposition (3) and its proof in Appendix C, substituting in the corresponding asset price expression (3.17) gives $\underline{CR} l \left[1 - \frac{\theta(1+i_0+i_1)}{\pi(1+i_1)}\right]$

and $\pi(1+i_1) > \theta(1+i_0+i_1)$. Together they imply the following:

$$0 < \underline{CR}Ml\left[1 - \frac{\theta(1+i_0+i_1)}{\pi(1+i_1)}\right] < \underline{CR}Ml.$$

It means the right hand side is negative, so $[z+(P_{-1}-N)i_0l_{-1}]-\underline{CR}l(P_{-1}+P_0) < 0$ and the proof is complete.

Appendix E

Datasets for Chapter 4

E.1 Construction of quarterly time series data for this chapter

The data used in the estimations involve different bank loan series, corresponding bank loan rates, and different time spans. For data which are reported monthly, the data points for March, June, September and December are used to construct the quarterly series. If data are reported quarterly, then the figures reported for each quarter are used for analysis. None of the series is seasonally adjusted.

E.2 Data used for estimation

A) Total commercial lending: 1990Q1 to 2007Q4

The data is taken from Reserve Bank of Australia (RBA) Bulletin Table D5. It is non-seasonally adjusted. 'Commercial lending' includes bank lending to other banks, NBFI's, trading companies, unincorporated, non-profit, government and private entities for business purposes. It excludes securitisations. Between 1990Q1 and 2000Q2, the monthly figures are averages of weekly information. After that, datapoints are end of month numbers. The series used is discounted by the CPI. The CPI series is taken from RBA Bulletin Table G2.

B) Large business loans (above A$2m): 1993Q4 to 2007Q4

Data for business loans is obtained from RBA Bulletin Table D8. It is non-seasonally adjusted and reported quarterly. This category of loans is divided into different industrial sectors and also classified according to amounts. The data used in this chapter is the total across all sectors, and the highest category, those above A$2m, is considered large and taken as a proxy for lending to large firms. The series used is discounted by the CPI. The CPI series is taken from RBA Bulletin Table G2. As mentioned in the text (in section 4.4), the A$2m amount that divides this series with under A$2m is not adjusted for inflation. Without information on the sizes of individual loans, it is impossible to have a more precise representation of large loans.

C) Small business loans (below A$2m): 1993Q4 to 2007Q4

Similar to loans above A$2m, this series is obtained in RBA Bulletin Table D8. The series used is discounted by the CPI. The CPI series is taken from RBA Bulletin Table G2.

D) Lending rate for large business loans (above A$2m): 1993Q4 to 2007Q4

The data is taken from RBA Bulletin Table D8. It is reported quarterly. The 'weighted-average interest rates on credit outstanding' is used to construct the spread variable in this chapter, and includes all variable and fixed rate loans but excluding impaired loans. The RBA records amounts of loans outstanding at different ranges of loan interest charged. The range of each bracket is 1%. The weighted average is calculated using the mid-point of each range. The data is used to construct the spread variable SC in this chapter.

E) Lending rate for small business loans (under A$2m): 1993Q4 to 2007Q4

Similar to lending rates for large business loans, this series is taken from RBA Bulletin Table D8. The data is used to construct the spread variable SB in this chapter.

F) Bank lending rate: 1990Q1 to 2007Q4

This series is taken from International Financial Statistics, series '19360P..ZF...'. As described in International Monetary Fund (2011), this rate is an average of rates on loans mainly to large businesses. However, a definition of what constitutes a large business is not given. From January 2007, it records the rate charged on standard housing loans. Absent a better measure of average rates for commercial lending with a longer horizon, this data series is used to construct the spread variable SA in this chapter, to be matched in estimation with the volume of total commercial loans..

G) Bond rates: 1990Q1 to 2007Q4

The data is taken from RBA Bulletin Table F2 (monthly). As mentioned in the text in Chapter 4, there is a lack of commercial bonds data that goes back far enough for the estimations. Hence the data series used here is the government bond yield. Data for 5-year and 10-year government bonds are available, but for loans to business the 5-year-maturity yields seem closer to reality as a proxy for business loans. The monthly average of the last month of each quarter is used in this chapter for constructing the spread. These averages are the 'midpoints of predominant bid and offer quotations in each market'.

H) Consumer Price Index: 1990Q1 to 2007Q4

The data is taken from RBA Bulletin Table G2. The series for 'all groups' is used. It is reported quarterly and not adjusted seasonally. The figures are used to discount the nominal amounts of bank loans, deposits and foreign currency liabilities in this chapter. For details on how the Australian Bureau of Statistics calculates the CPI, please refer to Australian Bureau of Statistics (2009).

I) Bank deposits: 1990Q1 to 2007Q4

The series is constructed by finding $(M3 - currency)$ and then discounting it by the CPI. See below for information on data on M3 and currency in circulation.

J) M3: 1990Q1 to 2007Q4

The data is taken from RBA Bulletin Table D3. The non-seasonally adjusted series is used. As documented in the RBA tables, between 1985Q2 and 2000Q2, the monthly figures are averages of weekly information. After that, datapoints are end of month numbers. This series is used to construct the data for the deposits variable in the estimation.

K) Currency: 1990Q1 to 2007Q4

The data is taken from RBA Bulletin Table D3, and includes notes and coins held by the private sector (excluding banks). The non-seasonally adjusted series is used. As documented in the RBA tables, between 1985Q2 and 2000Q2, the monthly figures are averages of weekly information. After that, datapoints are end of month numbers. Along with M3, this series is used to construct the data for the deposits variable in the estimation.

L) Foreign currency liability: 1990Q1 to 2007Q4

The data from 1989Q1 onwards is taken from RBA Bulletin Table D3. Prior to that, up to 1986Q3, it is reported in Table C7, and between 1986Q4 and 1988Q4, in Table C8. The series used in this chapter is total liability denominated in foreign currency, and are not seasonally-adjusted. The monthly figure of the last month of each quarter is discounted by the CPI and used in this chapter for estimation.

M) Real GDP: 1990Q1 to 2007Q4

The data is taken from RBA Bulletin Table G10. Reported quarterly by the Australian Bureau of Statistics, it is seasonally adjusted and calculated as an average of the income, expenditure and production approaches. For details on how the data is collected, please see Australian Bureau of Statistics (2011).

E.3 Variables in the estimations

1) Log of real Deposits = (M3 – currency) / CPI

2) Log of real Loans = Bank loans / CPI

3) Spread = Loan rate - bond rate

SA = Bank lending rate - 5-year government bond yield

SB = Loan rates under A$2m - 5-year government bond yield

SC = Loan rates above A$2m - 5-year government bond yield

4) Log of real Foreign currency liability = Foreign currency liability / CPI

Appendix F

The Australian banking sector and development of securitisation

F.1 The Australian banking environment

Prior to deregulation in the 1980s, the Australian banking industry was heavily guided by governmental decree. Interest rates were limited by arbitrary ceilings and banks had to hold particular kinds of securities. As well, the number of banks in existence and their lending policies were also dictated by the government. This represents an environment very different to the banking sector today. A full account of the Australian banking environment at the time is contained in the government report named *A Pocket Full of Change* (Martin (1991)).

Such regulation distorted the banking sector and reduced the effectiveness of monetary policy. It constrained banks' growth relative to other financial companies, and gave rise to the opening of many non-bank financial institutions (NBFI), which were not regulated but were frequently owned by banks. That way, the importance of bank lending dropped and it reduced the efficacy of monetary policy. It made banks uncompetitive and the incumbent set of regulations somewhat redundant. See Hunt and Terry (1997).

Regulatory reforms started in the early 1980s in Australia with the release of the Campbell Report in 1981 (Committee of Inquiry into the Australian Financial

System (1981)), the first such inquiry since 1937, recommending the removal of regulatory controls to be replaced by market-oriented forms of intervention and floating the Australian dollar. The recommendations are seen as promoting the role of market-based discipline (see Jensen (1986) and Jensen (1988)).

Following this report, in December 1983 the Australian dollar shifted from a fixed peg to a floating regime. In February 1985, foreign banks were allowed to operate in Australia under local licence and could compete directly with local banks (see Tyree and Weaver (2006)). Foreign currency borrowing rose dramatically as a result. A few months after the banking sector deregulated, foreign currency liabilities was 4.35% of total bank liabilities in June 1985, but stood at a peak of 42.31% in December 2006, and while abating somewhat, still remained above 35% throughout 2007.[1] These large numbers reflect the increasingly internationalised nature of banks' operations that can potentially reduce the impact of local monetary policy, in favour of international credit conditions.

In 1993, the Reserve Bank of Australia changed its main tool of monetary policy (Stevens (1999)). It went from manipulating monetary aggregates to using the interest rate to target inflation, like much of the western world at the time. From that time onwards, Australia's inflation rate has steadily dropped and has remained at a low level, similar to the experience of other OECD countries.

The Wallis report released in 1997 (Committee of the Financial System Inquiry (1997)) recommended completely dismantling the 'six pillars policy', allowing the four major banks (ANZ, Commonwealth, NAB and Westpac) and the two big insurance companies (AMP and Colonial) the chance to merge. This was only partially accepted by the government, which retained a 'four pillars policy', preventing the four big banks from engaging in any cooperative conduct. Ostensibly the government opined that allowing the four big banks any chance to merge would result in a behemoth that would dominate the Australian market, creating a monopolistic

[1] Author's calculation. Data from Reserve Bank of Australia Bulletin Statistics Table B3 and D3.

environment instead of fostering competition. This is despite arguments by the big four and sections of the public that a larger Australian entity will allow it to compete better for international market share, and the fact that a merged entity between any two of the big four will still be dwarfed by the world's largest banks. See Reuters (2008).

F.2 Securitisation and bank lending

One effect of deregulating the banking sector and financial markets in Australia is that over time, financial institutions have found new ways to conduct their business and developed new profit centres. As a result, banks in Australia have regained market share from the NBFIs. The development of a vigorous market for financial securities means debt financing is not any more the only way of raising funds. This has resulted in the emergence of many specialised institutions entering the market engaging in the trade of such instruments, and banks increasingly developing securities trading as a major activity alongside traditional lending.

Despite the advantages deregulation has given banks over NBFIs, Edey and Gray (1996) suggest there are other new sources of competitive pressure for banks, namely that of NBFI's ability to offer some intermediation products without having to supply the full set of banking services. So to some extent, the level of competition in the Australian banking sector is tighter than meets the eye. This may suggest the influence of bank networks in Australia is not as strong as first appears, lending support to the bank lending channel exerting a considerable influence on the market for bank loans. In particular, the subsequent growth of securities markets has made deposits a less important source of funding for financial institutions that seek to provide intermediation services. This points to a changing role of bank loans in the monetary transmission mechanism.[2]

[2]It must be noted that the new demand for funds has in turn expanded the interbank lending market. To the extent that monetary policy can affect interbank lending, bank loans may still play an important role in transmitting official policy.

Technological innovation has at the same time reduced the cost of obtaining information on the market. The increase in bank securitisation of loans into financial instruments and offering to the market is hence mirrored by a similar increase in participation by retail and institutional traders (which ultimately sell to retail customers). The quick dissemination of information on the internet has lowered the cost of trading, and may serve to lower an economy's reliance on bank finance, reducing information asymmetries. Also important are steps taken by accounting and financial market regulators to ensure timely disclosure of better financial information by companies, and cooperation between Australian and international regulators to harmonise disclosure requirements.

As a result, market-based financial activities have rocketed. The number of listed companies on the Australian stockmarket has grown steadily, from 1136 at the end of 1990 to 1988 at the end of 2007, a rise of 43%.[3] The market capitalisation of domestic companies listed in Australia, as a percentage of GDP, has jumped from 136% to 529% in the meantime. This is a big increase with average compound growth rate of almost 15%, compared to just over 6% in nominal GDP, meaning a larger number of companies are now able to use equity for finance, instead of having to rely on bank borrowing.[4]

The result of deregulation for banks is reduced market concentration of banking activity in Australia. Before foreign competition was introduced in 1985, many NBFIs in the 1960s and 1970s were owned by banks, in effect allowing the banking groups to dominate. Parallels can be drawn with the experience of many European countries in the same period. For example, in a study of the Portuguese banking sector, which opened to foreign competition and also relaxed banking regulations in the 1980s and 1990s, Ferreira (2007) alluded to the subsequent continuous fall in interest rates in the 1990s as a reason for the enormous rise in bank credit. The falling trend in interest rates is perhaps also because of the competition from foreign

[3] Source: World Federation of Exchanges.

[4] Author's calculation, data sources from International Financial Statistics, Reserve Bank of Australia Bulletin Statistics Table F11, and also World Federation of Exchanges.

banks, as a result of Portugal having joined the European Union.

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